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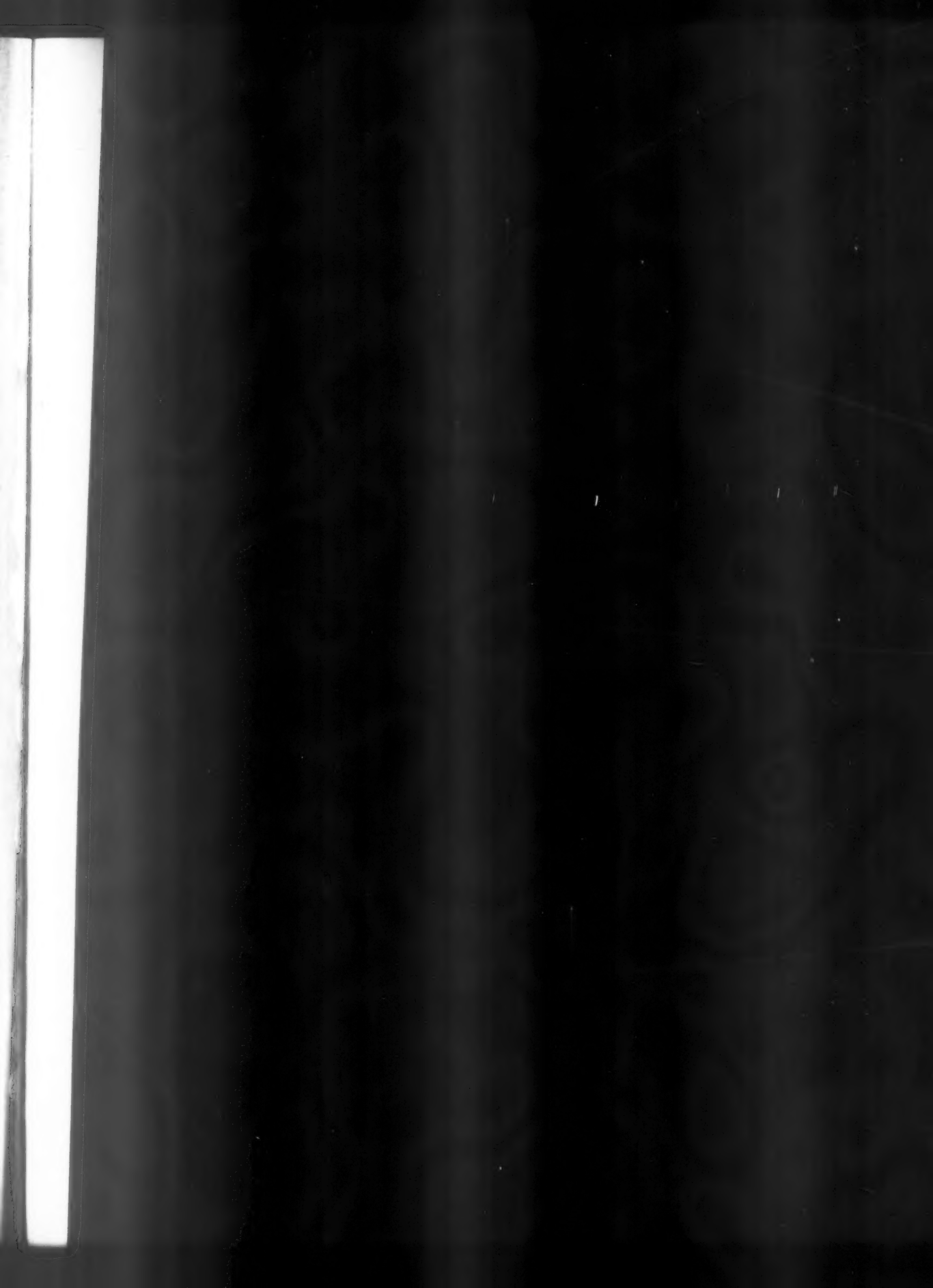
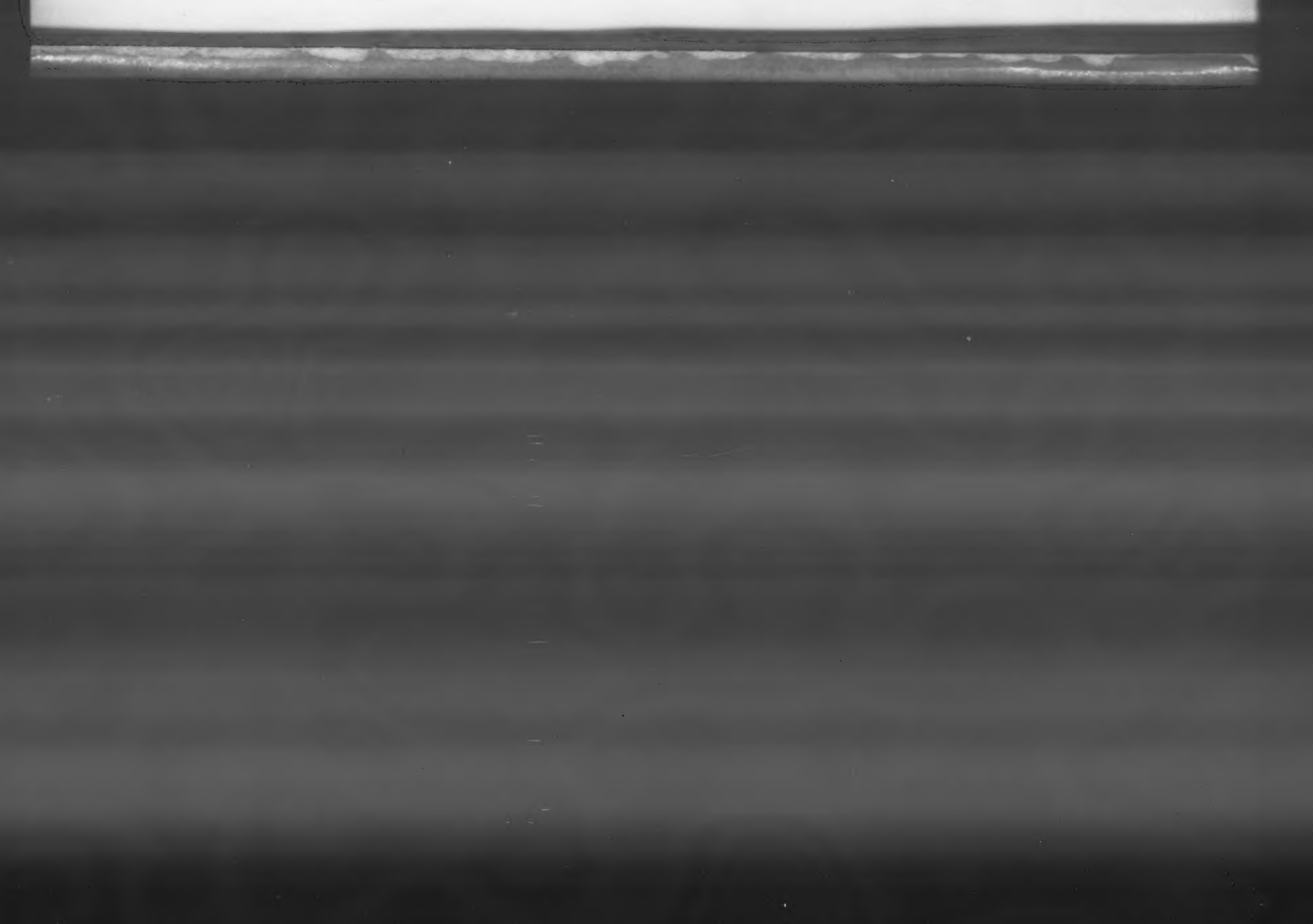




MUNICIPAL ENGINEERING

VOLUME XXVII AUGUST, NINETEEN HUNDRED FOUR NUMBER TWO

CONCRETE-STEEL BRIDGES AT DAYTON, O.

In 1903 the city of Dayton constructed across the Great Miami River on Main-st. a concrete-steel arch bridge of seven spans, using the Melan design and method of construction. Another bridge of the same sort and with the same number of spans has been designed for the river crossing at Third-st. and will be constructed as rapidly as possible. We are indebted to the Concrete-Steel Engineering Company of New York, the consulting engineers on the two bridges, and to Mr. G. R. Stattelmann, the resident engineer in charge of the construction of the bridge under Mr. F. M. Turner, City Engineer, for the data concerning the bridges and for photographs and drawings showing the details of construction, which are similar in the two bridges, and the finished result for the Main-st. bridge.

The river is confined by levees in the vicinity of these bridges, as the high water frequently rises considerably above the adjoining parts of the city. The low water elevation is about twenty feet above datum and the high water mark is forty feet at the south levee and thirty-nine feet at the north levee at Main-st., the difference being due to the current and a bend in the river. The elevation of top of both levees was 43.52 feet, only three and one-half and four and one-half feet respectively above high water mark. Main-st. ascends to the south levee with a grade of about 2½ per cent, and descended from the north levee with a 3.8 per cent grade. Under these conditions it was imperative not to obstruct the waterway more than absolutely necessary so as not to increase the danger of flooding the city, while on the other hand the floor of the new bridge had to be kept as low as possible in order not to increase the already heavy grades of the approaches. A stone arch bridge, aside from its prohibitive cost, was, therefore, out of the question, and after considerable investigation it was concluded that a concrete-steel bridge at this location would best meet the requirements for a permanent bridge.

The Main-st. bridge is a seven-span Melan concrete-steel arch bridge, of a total length of 588 feet between abutments, and 54 feet wide in the clear. The springing lines of all arches are located 1 foot below the high water line at all piers and 1½ feet below high water at the abutments. The elevation of the roadway at the south abutment was raised 1.8 feet, thereby slightly increasing the grade of the south approach, while the elevation of roadway at the north abutment remains the same as in the old bridge. The length of spans ranges from 69 feet at the ends to 88 feet for the center arch, while the proportion of rise of arch to length of span increases from 1-13 to 1-10. In order to reduce the thickness of the piers to a minimum it was determined that all arches should have practically the same horizontal thrust, i. e., the smaller the arch span the flatter it had to be, in order to counterbalance the greater weight of the adjoining longer arch. The strain sheets, which were made for the four different spans, show that the horizontal thrust ranges from 88,500 lbs. to 91,500 lbs. per lineal foot. The arches were dimensioned for a live load of 150 pounds per square foot, and two lines of 40-ton electric motor cars. The distance between crown of arch and crown of roadway measures from 13 to 15 inches, so that the railway tracks practically rest directly upon the arch at the center of each span, causing heavy concentration of loads at these points.

The piers and abutments were dimensioned for a maximum pressure of about 4 tons per square foot on the foundation, which was supposed to be good solid gravel and sand.

Bidders were invited to submit proposals based upon the concrete-steel bridge plans and specifications, which were placed on public file, or to submit proposals for a seven-span plate girder bridge, according to bidders' own design.

A separate proposal for a temporary bridge 24 feet wide, capable of carrying 40-ton electric motor cars, was required of each bidder.

Eight bids were received for a steel plate girder bridge, and seven bids were received on the concrete-steel design.

Bids received for a plate girder bridge ranged from $124,864 to $191,860. The bids for concrete steel bridge, according to the plans submitted by the Concrete Steel Engineering Company of New York, were as follow: Frank A. Bone of Lebanon, $140,000; R. A. Cummings, $163,900; Moore & Mansfield, $130,738; Charles H. Haglen of Dayton, O., $128,950; H. E. Talbot & Co. of Dayton, $128,170, and on a modified plan, $123,170. This latter bid contemplated cutting off six feet of the foundation of the piers and substitute piles therefor. This bid was accepted by the Board of City Affairs.

Work on the construction of the temporary bridge was commenced July 22, 1902, and the first car went over it on Aug. 27. Travel across the old bridge was then stopped and dismantling the same commenced.

Immediately after finishing the temporary bridge, two pile drivers were rigged to drive piles for the support of the falsework. These piles were driven 8 feet apart crosswise and from 10 to 12 feet apart lengthwise. They were cut off 2 feet 8 inches below the intrados of the arches and a cap 4x12 inches placed on them; then came two wedges averaging 9 inches, and above these was a stringer 8x12 inches, which carried the joists, 2x12 inches, cut to conform to the curve of the arch. The flooring consisted of 1-inch boards 6 inches wide.

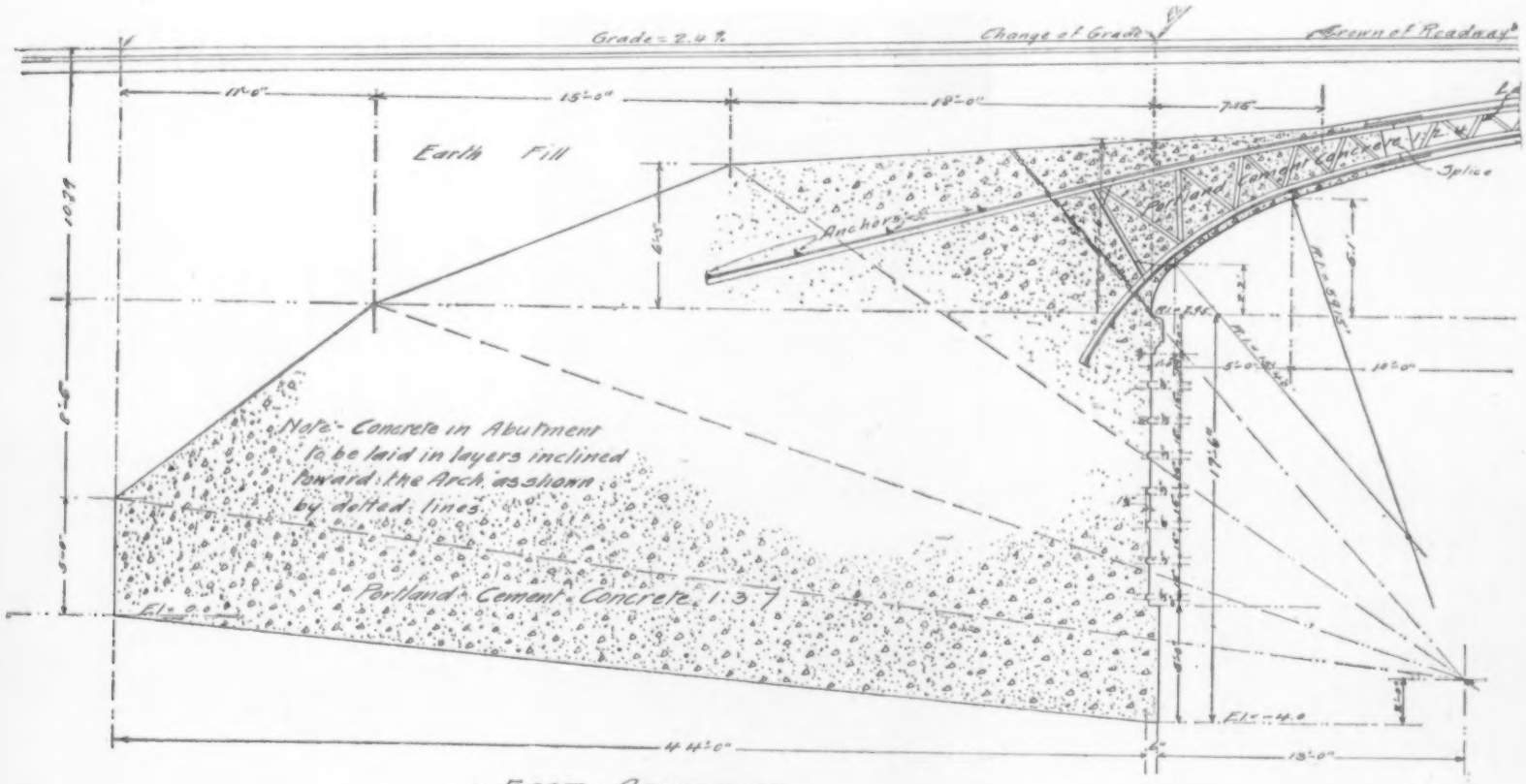
Cofferdams were built for the construction of the piers. The material excavated consisted of gravel, under which a layer of hard-pan clay and gravel was struck; this layer sloping down stream. Piers 1 and 2 were excavated to elevation 12.5, a distance of 7½ feet below low water and about 5 feet below the bed of the river

The excavation in piers 3, 4, 5 and 6 was only carried down to elevation 14. In piers 5 and 6 no hard-pan was struck; in pier 5 piles were driven 20 ft. without striking hard-pan.

At the north abutment the material was mostly filled earth,, and the natural bottom consisted of water bearing sand overlying gravel. A great amount of water was struck. Three pumps were, however, kept going, which created a draft for the water all around. Finally it was decided to start concreting at the elevation of 14.50 instead of 11.50, as no wash may be expected on this side of the river. Pumping was stopped and the concrete was deposited under the water. It was not before Feb. 1, 1903, that the foundation was in for this north abutment, as the high water level during the winter months greatly augmented the local trouble.

It being optional with the contractor to use crushed stone or gravel in the concrete for the piers and abutments, he choose to use gravel, as the river bed is

CONCRETE STEEL BRIDGE, MAIN STREET, DAYTON, O.



- EAST ABUTMENT. -

CONCRETE STEEL BRIDGE, DAYTON, O.
Section of Abutment.

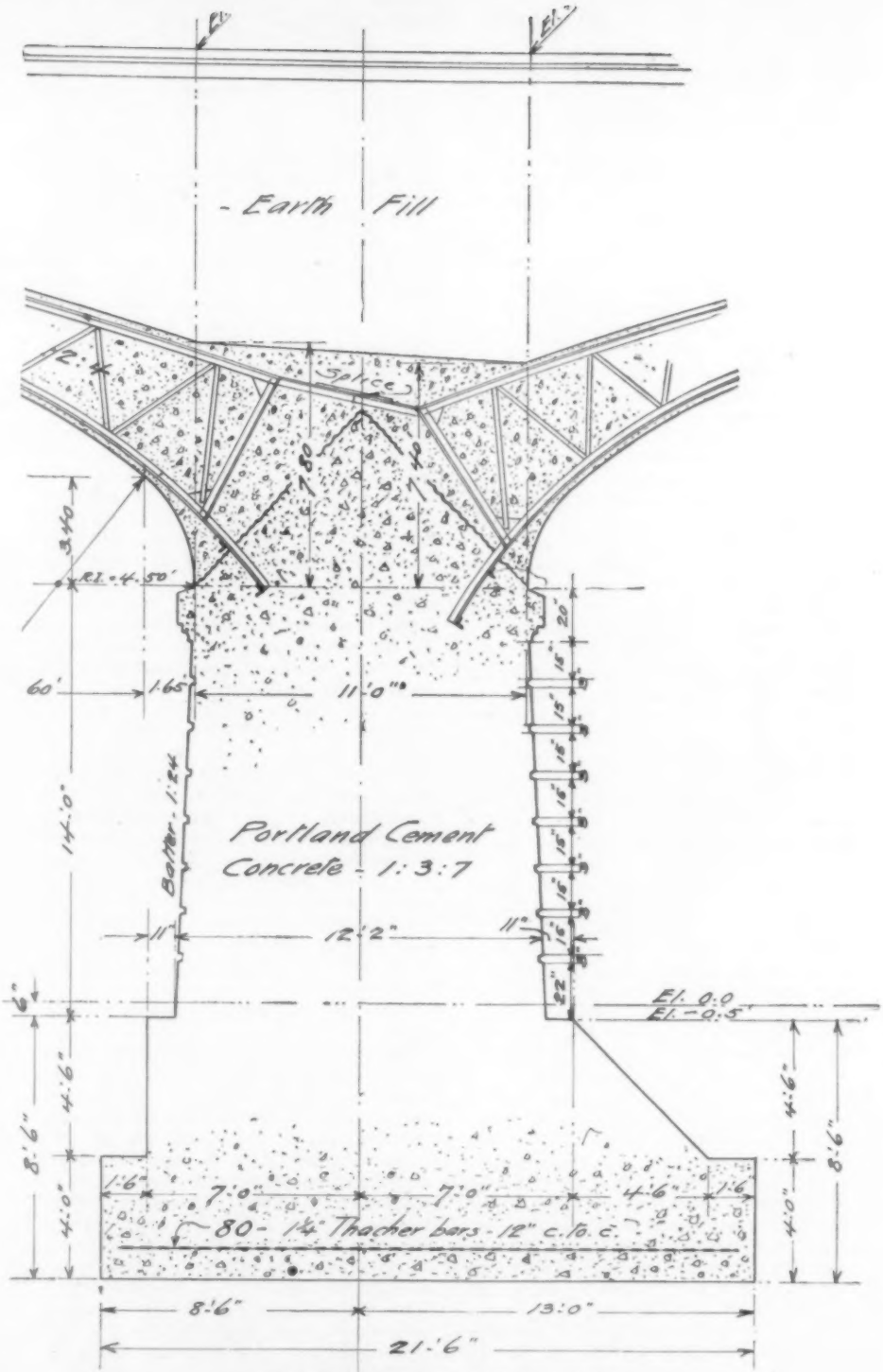
a natural gravel bottom. To procure and to wash and separate the sand from the gravel the contractor put up a 10-in. centrifugal pump and tried to pump the gravel to an arrangement designed to screen and wash the sand and to run the sand and gravel into separate bins. On account of the large pebbles, or rather boulders, which lodged in front of the screen and caused the pumpage of more water than gravel, this scheme did not work well, and the following method was adopted: The gravel was excavated by means of an orange-peel dredge, run on a moving derrick, and the gravel so delivered was hoisted by means of an endless chain conveyor and dumped at a hight of about 25 feet into a screen, one section of which was of ¼-in. mesh and the other two sections were of 2-in. mesh. A stream of water was thrown into this screen and the gravel and sand so washed dropped into separate bins. The larger pebbles were run out on the other end of the screen to be used in the crusher. When freezing weather had set in, this washing and screening of gravel was stopped and unscreened gravel was used first only in the abutments, but afterward in the piers also.

The concrete in the piers was of the proportions of 1 of cement to 2 of sand and 6 of stone or gravel, and for the abutments 1 of cement to 3 of sand and 7 of stone or gravel. The piles in the piers were cut off at about an elevation of 15 and the first batch of concrete was deposited in pier 1 on Oct. 22 at 4 p. m. By the end of the month of October pier 1 was concreted up to an elevation of 21.50.

Concreting was frequently interrupted by high water for a few days. After the water had receded, cold weather and snow set in and concreting progressed very irregularly. Work, however, was never abandoned and concrete was put in whenever it was possible. No concreting was done at a temperature below 15 degrees and when the temperature was below freezing warm water and salt were used in mixing. The washing and screening arrangement of the gravel could not be worked in freezing weather and all gravel was used as it was taken out by the orange-peel, except that large boulders and chunks of dirt, that had caved in, were thrown out. Concreting in the piers and abutments was kept up and on Jan. 13 a night crew was put on to hasten the work. On Jan. 16 the south abutment was finished ready to start the concreting of the arches.

CONCRETE BALUSTRADE, EDEN PARK BRIDGE, CINCINNATI, O.
Showing Surface Cracks.

The concrete for the arches was composed of 1 part cement, 2 parts of sand, and 4 parts of broken stone that would pass through a 1½-inch ring, but some stone up to 2 inches was used. The concrete for the arches was mixed medium wet so that light tamping produced a slushy mass. A coat of mortar was first spread over the flooring and then the concrete was deposited on this layer of mortar. At first it was intended to con-



CONCRETE STEEL BRIDGE, DAYTON, O.
Section of Pier.

crete the arches in transverse sections about 15 feet wide. The skewbacks on the abutments and over pier 1 were run up to that width and then another section was started. On account of an accident the work had to be suddenly suspended on this second section by the night crew, and layers were left of different depths, varying from 4 inches to 1 foot or more. Very cold weather set in and the concrete of this section froze entirely through. On the afternoon of the second day following, work was resumed, the layer less than 4 inches thick was cut out and the other layers thawed out with steam and then concreted as usual. By midnight the following day this first arch was completed. The actual working time consumed on the arch was about 50 hours.

The concreting on the other arches was done by longitudinal sections comprising generally five spaces. Concreting was started from the skewbacks on both sides and from the crown towards the skewbacks. The skewbacks were always concreted beforehand for a length of about fifteen feet up the haunches. A partition was put up so that each section was completely finished before another was started. Before commencing the next section the joints were roughened up and a coat of cement mortar applied. Care was taken to get the concrete under the flanges and around the steel ribs. Special tamping irons like those used for tamping under railway ties were used in this. On February 14 the last span was closed.

On March 17 the wedges under span 1 and 2 were loosened and a start was made to take out the falsework. Levels were taken before touching the wedges and the elevation of the spandrel wall fixed at 46.21. Immediately after all wedges in span 1 had been loosened, the elevation sank to 46.16, and after the second span was loosened it rose again to 46.19. On April 13, after all the falsework was taken out of the entire bridge, the elevation had returned to the original one of 46.21. Spans 2 and 3 each settled in similar way from 0.02 and 0.03 feet, and both came back to their original hight. After the falsework of the center span had been taken out, it settled from elevation 50.67 to 50.61, and came back only to 50.63 after all the supports of the adjoining spans were removed. On span 5, 6 and 7 very little change in the elevation was noticed. In order to allow for a settlement the falsework had been raised from 0.1 to 0.15 feet above the required hight. The total real settlement, however, was only noticed in the center span, and this amounted to only 0.04 feet.

The aggregates for the concrete were hoisted up an inclined plane in dump cars and dumped into a hopper from which they were introduced into a cubical box mixer revolving on a horizontal axis passing through two diagonally opposite corners. Eighteen to twenty turns were given to a batch. After a few turns, water was admitted, which passed through the shaft, and after being mixed the concrete was discharged into boxes on small cars.

The tops of the arches were coated with a coat of cement mortar ½ inch thick, over which a coat of tar, out of which the oil had been extracted, had been spread.

On both sides of the bridge next to the spandrel walls were laid gas pipes, a 3-inch on the east and a 6-inch on the west for artificial gas and an 8-inch on the east side for natural gas. Besides these pipes there were under the sidewalk on the east side thirteen conduits built in by the city for future use, while under the sidewalk on the west side the Central Union and Home Telephone Companies put in conduits.

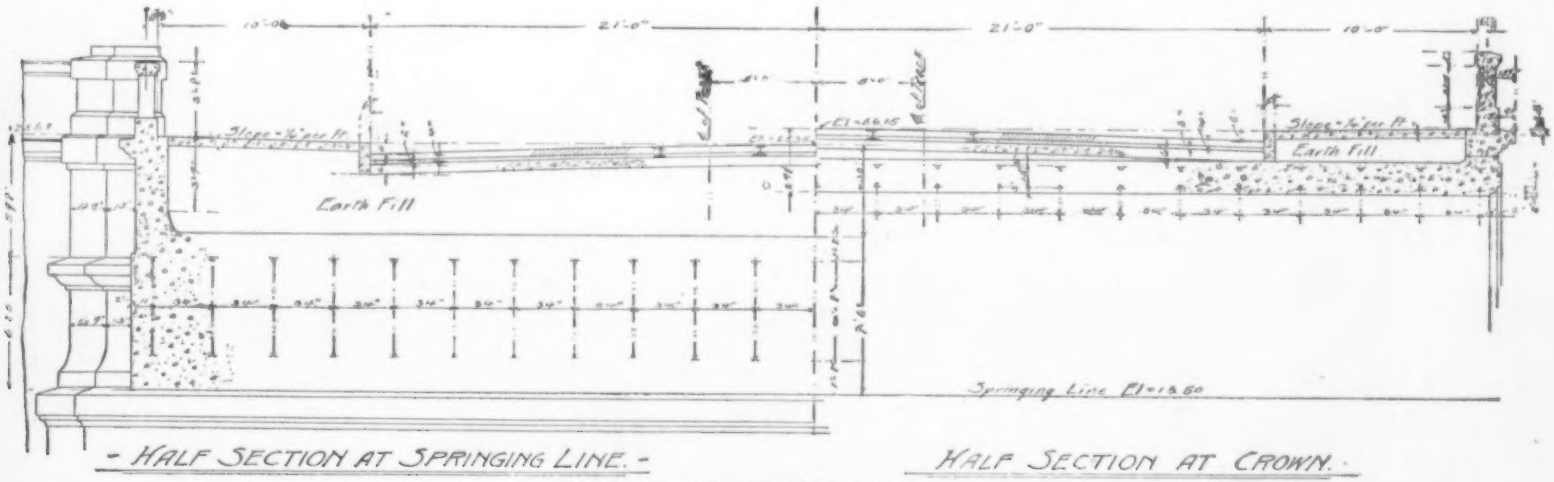
The track for the street cars was laid by the railway company, and 7-inch rails were laid on 8-inch ties. On top of the arches only 4-inch ties were used, and sand was used for filling under them.

The roadway was paved with brick on a concrete foundation of 5 inches and a 1-inch sand cushion. The curb and sidewalks were constructed of concrete. The elevation of curb is 1 inch above the rail, and the gutter is 5 inches deep, thus the bottom of the gutter is 4 inches below the top of rail. The width between curbs is 40 feet, the dummy track is 4 feet 6 inches wide, and the sidewalks 7 feet wide. The railings and pedestals are molded concrete, and were made in molds and set like stone.

The bridge was formally opened on July 22, 1903.

The accompanying photograph shows the completed Main-st. bridge. The only complaint concerning its appearance seems to be the checking or hair cracks of the parapet blocks and the exposed faces. The difficulties as regards temperature, and some lack of proper care in manipulation of the concrete in casting the stones, are assigned as the reasons for the observed defects, which affect the appearance only and do not affect the strength or durability of the structure.

Mr. Stattelmann reports that some of the stones were made in October and November, 1902, and expresses the opinion that they were made too dry and were not sufficiently tamped, causing them to be quite porous. After taking from the molds they were placed in the river bed



CONCRETE STEEL BRIDGE, DAYTON, O.
Cross-Sections of Arch.

immersed in the water and kept thus until set in May, 1903. They were not dry when exposed to the sun and the surface dried very quickly, while the interior could not conform with sufficient rapidity to the changes in the condition of the outer surface. Some stones, requiring patching, were repaired while exposed to the sun and were permitted to dry quickly. A wash of cement was applied after the stones were set. Our readers will recognize several good reasons for the formation of hair cracks on the surface. The fact that the frost damaged some of the stones last winter is further evidence that they are too porous.

The accompanying small cut shows the condition of the Eden Park concrete bridge in Cincinnati. It is reported that the hair cracks, which are so prominent in the flat surfaces shown in the picture, do not appear on the ornamental parts of the stone, where the surfaces are not uniform and especially where they are not plane surfaces. Mr. Stattelmann also reports a door frame which shows the cracks where the sun strikes it but does not show them in the ornamental parts.

The accompanying drawings show some details of the structure of the proposed Third-st. bridge and are self-explanatory. The two bridges differ only in dimensions and in minor details.

THE THEBES BRIDGE OVER THE MISSISSIPPI RIVER.

The Southern Illinois and Missouri Bridge Company, under the direction of Noble & Modjeski, engineers, is building a bridge across the Mississippi River at Thebes, Ill., which is said to have the largest concrete mass in a single structure which has yet been built. Four roads, namely, the Illinois Central and the Chicago & Eastern Illinois on the east side, and the Missouri Pacific and the St. Louis & Southwestern Railway on the west side, are interested in its construction. It is to be a double-track, high level structure. Its location is a particularly fortunate one owing to the high bluffs on each side of the river which obviate the necessity of the usual long approach trestles.

The bridge will consist of a continuous steel structure of five spans. The central, or channel span, will be 671 feet long; the two spans on either side of the channel span will be 518 feet 6 inches long; the two fixed spans on either side of the channel span will be 75 feet high between centers of chords; the suspended spans will be 55 feet high between chords at the center; the distance to center of trusses will be 32 feet. There will be approximately 14,000 tons of steel in the structure.

The six main piers supporting the steel superstructure will be founded on rock; five of them by pneumatic process with wooden caissons. The westerly pier will be founded in open excavation, as solid rock is very near the surface of the river bottom. The deepest pneumatic foundation will be at about 50 feet below low water.

The total hight of the structure from the bottom of the lowest foundation to the top of the highest point on the superstructure will be 231 feet.

The chief difficulty encountered in the pneumatic foundations has so far been the irregular formation of rock, it being necessary to sink the caissons through boulders, shale and hard rock, until the point was reached where the entire pier could rest on solid hard rock. This required a great deal of blasting inside of the working chamber.

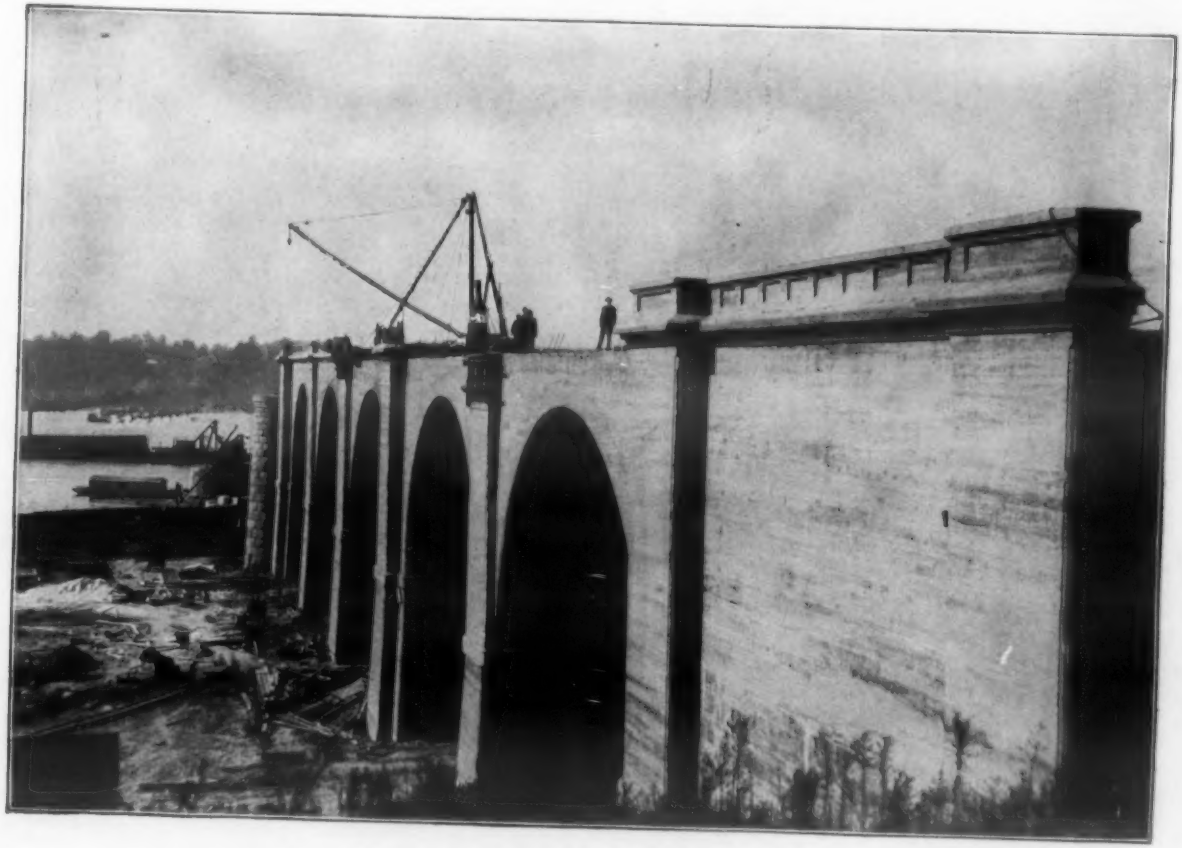
The face stone of the piers will be of buff Romona oolitic stone. The piers will be backed with Portland cement concrete. Granite is used for nose stones of the cut-water and for the bridge seats.

The bridge is approached at both ends by concrete arch approaches. There are five 65-foot arches in the east approach and six 65-foot arches and one 100-foot arch in the west approach.

The foundations of these approaches are either on shale or on rock, as the case may be, and with the exception of one pier, have so far all been in open excavation. One of the piers in the east concrete approach, where a considerable amount of quicksand was encountered, was founded by a concrete-steel caisson by means of open excavation. This foundation was quite successful, and other foundations in the west approach may be effected in the same manner.

The concrete in the approaches is of Portland cement. Its total amount is estimated at 35,000 cubic yards.

The east approach to the bridge commences at the junction of the Illinois Central and Chicago & Eastern Illinois tracks 2.1 miles from the east end of the bridge. The total amount of excavation in this approach will be 260,000 cubic



THEBES BRIDGE OVER MISSISSIPPI RIVER.
Concrete East Approach.

yards. The grade will be 0.5 per cent compensated on curves.

The west approach begins at the junction of the Southern Illinois and Missouri Bridge Company's tracks with the St. Louis & Southwestern tracks 1.9 miles from the west end of the bridge. It ascends to the bridge with a maximum grade of 0.5 per cent compensated on curves. The total excavation in this approach will be 300,000 cubic yards. The road-bed on both approaches will be double track, ballasted and 85-pound rails will be used.

The total length of the bridge proper, including concrete approaches, will be 3,807 feet.

The total length of the entire construction, including earth approaches, is 4.7 miles.

Fifty thousand barrels of "Chicago AA" brand of Portland cement are used in this work. We are indebted to the Chicago Portland Cement Company for the above description of the bridge and for the accompanying illustrations of the concrete approaches. They show three views of the arches of the east approach, taken on the same day, with the arches proper completed and the parapet wall under construction. The arches are semi-circular and are reinforced with 1¼-inch rods near the intrados and with two layers of the same size rods laid horizontally through the extrados at the crown. The projecting rods tying the concrete of the arch structure to the parapet wall can be seen clearly in the views of the arches.

PROBLEMS OF STREET PAVING.

The Commercial Club of Chicago recognized the necessity of a broader study of the problems of street paving and maintenance in that city and appointed a committee to consider the matter. Mr. John W. Alvord, a consulting engineer in the city, has recently made a report to this committee in which he takes up the various problems and proposes methods of solution with examples of the results of the application of these methods to special cases. Through Mr. Alvord's courtesy we present a number of the diagrams and tables which illustrated his report in connection with this abstract of some of his arguments and conclusions.

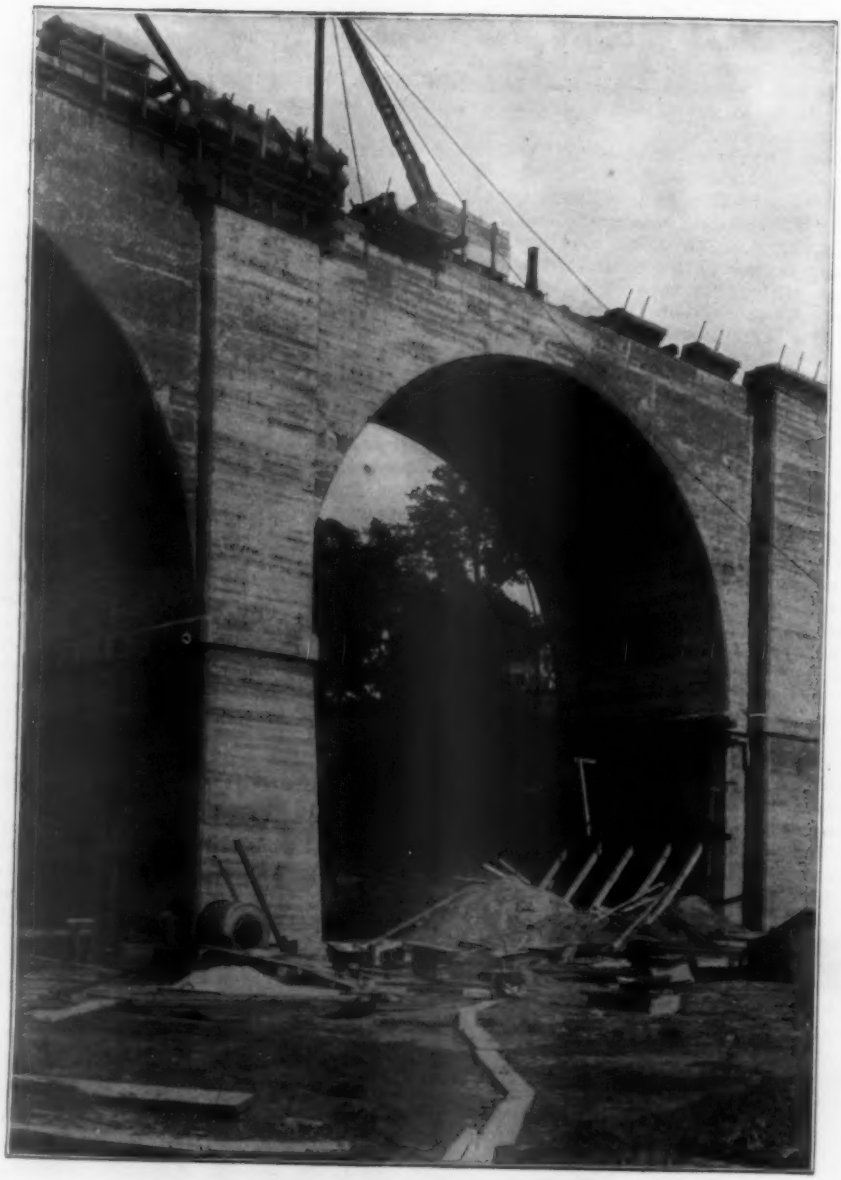
The importance of the subject is shown by the expenditure by the cities of this country of over $70,000,000 each year for pavement construction and renewals. The lack of proper study of it is accounted for by the frequent changes in municipal administrations and consequent continued ignorance of officials concerning first principles; by the fact that the taxpayers are given the opportunity to decide what materials shall be used, so that it would be necessary to educate the entire mass of taxpayers in order to produce any material effect upon conditions; because failures of pavements not suited to the conditions on given streets cause great fluctuations in public opinion regarding various materials and methods; because the taxpayers make what studies are made instead of delegating this work to technical experts who are broad enough to consider all sides of all the questions involved; because the ordinary taxpayer is distrustful of the ordinary municipal authority, fearing that personal or political advantages or lack of ability and knowledge make wrong decisions too nearly certain.

The methods of assessing the cost of pavements and their renewal and the lack of method in maintenance and the restriction of the problem to the local neighborhood also have their effect in preventing that broad treatment which most engineering questions receive.

The first consideration should be the amount and character of traffic which passes over a street. This can only be determined definitely by a census of the traffic, taken at as many places and at as many times as may be necessary to secure the data required. This is seldom if ever taken and if any attention is paid to this question an answer is assumed upon very general propositions having no statistical basis.

The streets may then be classified, and Mr. Alvord gives the following rough outline of such a classification with suggested answers to the various questions which arise regarding the treatment of each class.

Class One. Congested Retail Business District. Team traffic of from 5,000 to 10,000 tons per day, largely lighter vehicles. Large pedestrian traffic at crossings. Desirable width of street 100 to 120 feet. Broad roadways with width between curbs, 54 to 60 feet. Subways for all pipes and conduits of the public utility companies. Solid foundations for pavements. Highest type of noiseless and smooth pavements regardless of first cost or operating expenses, selected from point



THEBES BRIDGE OVER MISSISSIPPI RIVER.
Concrete East Approach.

of view of comfort and convenience to public. Grooved street car rail. Refuge stands at center of streets at cross walks, such as are usual in Paris on the Champs Elysees. Low curbing; frequent public comfort stations; occasional subway crossings for pedestrians; brilliant lighting; annual maintenance for cleaning and repairs, based on amount of traffic, and liberal in amount.

Class Two. Streets of Heavy Tonnage in the vicinity of docks, warehouses, depots, etc., without large working populations adjacent. Heavy traffic loads, aggregating 5,000 to 15,000 tons per day. Width at least 80 to 100 feet. Broad roadways, with width between curbs 45 to 60 feet. Pavements of the most enduring material, regardless of noise, on solid foundation, regardless of first cost. Refuge stands in center of streets at crossings. Fairly high curbings. Ordinary lighting.

Class Three. Second Grade Business Street, or a main artery of travel to country, carrying 1,000 to 5,000 tons per day of heavy loads. Wide roadways with width at least 50 feet between curbs. Medium depth of curb. Grooved street car rail. Subways for public utility companies. Durable pavements on solid foundations. Selection to be made with due regard to first cost and operating expenses.

Class Four. Fairly Well Traveled, High-class Residence Streets. Traffic ten to fifty tons per day, largely light vehicles and delivery wagons. Fairly narrow roadways, width 26 to 34 feet between curbs. Ample grass plots, and proper tree planting. Pavements on solid foundation, smooth and noiseless. Selected with regard to cost of operation, comfort, cleanliness and noiselessness.

Class Five. Unfrequented Residence Streets. Traffic nothing to five tons per day. Very narrow roadway, with width between curbs not more than 18 to 24 feet. Broad grass plots. Abundant tree planting.

The life of a given kind of pavement depends to a considerable extent upon the amount of travel over it. So far as it does so depend, exact data could be secured by means of the traffic censuses proposed. Where conditions of travel are changing these censuses should be taken often enough to insure complete data.

For streets with heavy traffic the traction force necessary over the various pavements is a controlling factor in making a choice. Experiments on this line are sadly lacking and should be made in detail.

The question of cost of repairs is also very important, but, owing to the lack of information on the matters already mentioned, there are no fixed methods of estimating the expense each year of the life of a pavement, and consequently no adequate provision is made for this essential part of the cost of a pavement; in fact, the cost of maintenance is often lost sight of until entire repaving is found to be necessary.

Width of pavements is often too great. Mr. Alvord estimates that Chicago has expended at least $10,000,000 for excess of width of pavements over what is really necessary. The ornamentation of street areas is also neglected, though not so much as formerly, thanks to improvement associations and similar organizations which fill out the lapses of the municipal authorities.

Exhibits 5, 6 and 7 show some suggestions made by Mr. Alvord regarding the treatment of three classes of residence streets as indications of what may be done with even greater economy than is now practiced.

The early pavements were laid to get the cities out of the mud, and cheapness was a prime requisite. Experience showed that good pavements at high first cost were cheaper in the end. Later increase in wealth developed demands for convenience, comfort and cleanliness without so much attention to cost, so far as large cities are concerned, and the same sentiment is developing in the smaller cities.

Whereas fifty years ago the only actual pavements were some class of stone, the percentages of the various paving materials used in the cities in the ten years ending with 1900 were: asphalt, 33; brick, 25; macadam, 23; granite, 8; wood, 7; others, 4 per cent. Exhibit 15 shows the tendencies in 135 cities during this period, showing the pavements laid with each kind of material and the kinds and amounts displaced, in percentages of the total amount of new paving.

Exhibit 4 shows the comparative annual cost of asphalt, granite and rectangular wooden block pavements in Chicago for business streets on assumed data for rate of wear and amount of traffic.

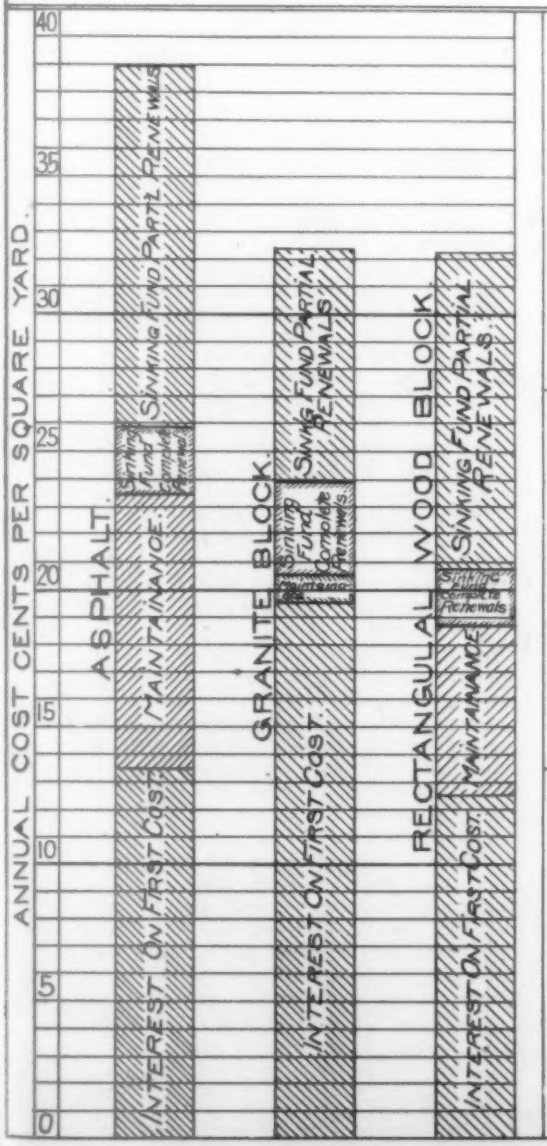
Exhibit 8 shows the cost of cleaning streets of various materials, assuming that the cost of the smooth pavements is represented by 100. This comparison is made on the authority of the street cleaning department in New York City.

The expenditures for street construction and for street cleaning and sprinkling per capita of population in several American cities are shown in exhibit 19. The in-

TO ACCOMPANY REPORT OF J.W. ALVORD

COMPARATIVE ANNUAL COST.

PAVEMENTS FOR CHICAGO BUSINESS STREETS.



ASPHALT.

ASPHALT $2.70, 3 RENEWALS	
INT. 1ST. COST @ 5%	.135
ANNUAL MAINTAINANCE	.10
ANNUAL S.F. Complete Renewal $2.70, 3%, 50 YRS.	.024
ANNUAL S.F. Partial Renewal $1.80, 3%, 12½ YRS.	.121
	.380

GRANITE BLOCK

GRANITE $3.90, Renewal	
INT. 1ST. COST @ 5%	.195
ANNUAL MAINTAINANCE	.01
ANNUAL S.F. Complete Renewal $3.90, 3%, 50 YRS.	.0346
ANNUAL S.F. Partial Renewal 3.00, 3%, 25 YRS.	.082
	.3216

RECTANGULAR WOOD BLOCK.

SQ. WOOD BLOCK (CREOSOTED)	
$2.50 3 Renewals. INT. 1ST. COST @ 5%	.125
ANNUAL MAINTAINANC	.06
ANNUAL S.F. Complete Renewa. $2.50, 3%, 50 YRS	.022
ANNUAL S.F. Partial Renewal $1.70, 3%, 12½ YRS.	.114
	.321

EXHIBIT NO. 4

creases per capita of the income of the city departments are given in figures with the graphical statement of street expenditures that one reason for the differences may be apprehended.

An interesting exhibit which has not before been made is found in exhibit 20, showing the percentage of vehicles using street car tracks on streets of various widths and amounts of traffic. This is very interesting but should be extended to other cities and other conditions of construction and operation before drawing any conclusions.

There are some very interesting diagrams in Mr. Alvord's report, which are not reproduced here, giving the results of traffic censuses in various streets of Chicago and its surrounding towns. They will repay careful study and, while not serving as definite guides for assuming traffic conditions where censuses have not been taken, will show tendencies and the need of care in assuming or measuring the effect of this important factor in the life of a pavement.

The magnitude of Chicago's problem, involving as it does the expenditure of $16,000,000 within two or three years in renewal and new construction of pavements is emphasized in the report and the consequent necessity of the careful and extended study of Chicago's actual conditions on each street to be constructed and of the materials which can be used, that this vast sum of money may be expended with the same good business management and technical direction which has gone, for example, into the construction of the drainage canal.

PAVING MATERIALS.*

By John W. Alvord, C. E., Chicago, Ill.

While but little study has been made of the broader principles underlying the art of street improvement, or data on the traffic streets must sustain, a large amount of literature has been developed as to the material of pavements, their constructive details and first cost. This is the only field which the municipal engineer has been allowed to occupy undisturbed, and he has covered it with great detail and minuteness, and placed on record a large amount of useful information. It is not the purpose here to do more than present, in a brief review, the salient features of various kinds of available pavements, so that they may be intelligently assigned to the various classes of improvements outlined elsewhere.

In reviewing the literature of this part of the subject, it may be desirable, first of all, to note that a considerable portion of the information available is to be credited to the contractors for monopolies, or the promoters of property interests in materials, and, therefore, while excellent in its way, is subject, nevertheless, to certain bias, and should be accepted somewhat guardedly.

A second thought which cannot be too strongly impressed is that available information as to wear and durability of pavements is quite incomplete, because of the absence of data as to travel, amount of repair, duration of life, and accurate statement of final condition. As a consequence, while we have knowledge as to first cost, no one can have much foundation for exact opinions as to the expense of operation and renewal of pavements upon which all real comparison depends. Hence the great variety of empirical ideas which we find expressed on this subject.

A third warning may be uttered to those who have preconceived ideas on this subject. The apparent failure of a pavement to meet expectations under every condition should not work final condemnation. Each pavement has its strong and weak points, and if placed in unfavorable environment will not develop its best qualities.

With these cautions, it may be well to attempt to outline, in only the most general manner, the strong and weak points of some of the better known and well tried forms of pavement, bearing in mind that upon this subject there are recently published volumes of well arranged material accessible to any one who is interested in the matter.

Asphalt. Asphalt pavements are a popular, high class pavement, comparatively noiseless, reasonably elastic, smooth and cheaply cleaned, and reducing the force required for traction to a moderate amount. When unclean and wet they are more or less slippery, but, nevertheless, even then, they give usually ample foot-

*From a report on "The Street Paving Problem of Chicago."

TO ACCOMPANY REPORT OF J.W. ALVORD.

SUGGESTION FOR
RESIDENCE STREET INTERSECTION
IN LOCALITY OF LIGHT TRAFFIC.

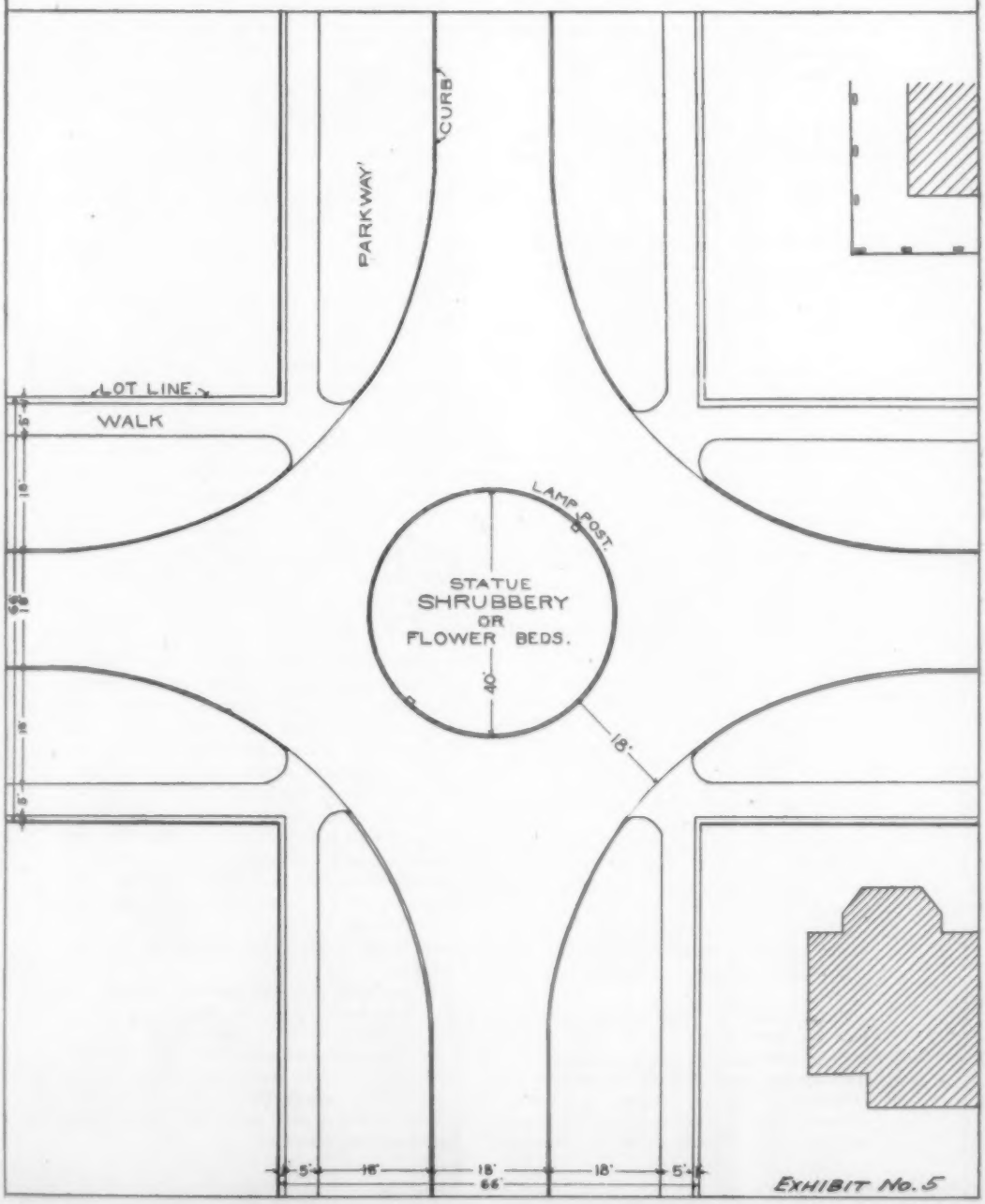


EXHIBIT No. 5

hold for horses except upon steep slopes.

Asphalt itself is a variable material, the only reliable test of which is its action in the pavement. Such pavements have frequently failed, but it is to be remembered that the industry is new and has been rapidly developed in less than thirty years to the point where there are now about 2,000 miles of street, representing an investment of over $100,000,000, in this country alone. The wearing surface of asphalt is composed of 90 per cent of sand or mineral matter, the asphalt being the cement that binds it into a tenacious and elastic coating. If, for any reason, such as improper preparation, age or volatilization, the cementing quality of the asphalt disappears, the pavement disintegrates, cracks, and is rapidly worn or broken down. The general tendency of asphalt pavement to decay will be indicated by its loss of elasticity during sudden changes of temperature, cracks forming during cold weather, and particularly during extreme drops in the temperature. This pavement is particularly sensitive to the action of the sun's heat, and to the combined action of rainwater, acids, oxygen and frost. Under such conditions it gradually loses its cementing power. It is an interesting fact, however, that asphalt pavements wear better and last longer when they are subjected to a considerable amount of travel. The elasticity of the pavement seems to be promoted and prolonged by use. Asphalt pavements require a considerable plant for their preparation, and experience and care in their construction, and are not a cheap pavement, either in first cost or operating expense.

Owing to the uncertainties of the manipulation of asphalt, a large number of cities in this country have adopted the method of laying it under a guarantee for a period of five, ten or fifteen years, during which time it is repaired at the expense of the contractor, and the amount so expended charged into first cost. This method confuses the data connected with operating expense, and as the periods vary in different cities, renders it difficult to make proper comparisons, especially as it is common to make the guarantee period uniform all over a given city regardless of whether travel is heavy or light.

This method of long guarantee periods has its advocates and its critics about evenly divided. The real problem of repair by the municipality begins after the termination of the guarantee, and is a question interesting many municipalities at this time. Should cities let out repair by contract, or should they establish their own asphalt plants and do their own repair work? With such plants established, the further question is raised as to the expediency of the doing away with the guarantee period and performing all repair. A valuable recent report of Mr. Tillson, chief engineer, Street Department of Brooklyn, is of interest as bearing upon this question. The city of Winnipeg has successfully established such a repair plant, and in other cities, notably Montreal and Brooklyn, they are being urged.

Asphalt pavements, consisting of only a binder coat and finishing coat, are laid in New York City as a cover to the older granite and stone block pavement, and it is claimed that the roughness of the older stone pavements forms an admirable bed for the asphalt coat, from which it does not easily detach itself, as would be the case with smooth concrete foundation.

Finally, then, asphalt pavements are particularly desirable on high-class residence streets, public squares and retail shopping streets, and even wholesale streets with heavy traffic, when noiselessness is to be desired. They are not unduly expensive for unfrequented residence streets when the width of roadway is adapted to the amount of travel. Asphalt pavements are not economical on streets of excessively heavy traffic, such as occur in the vicinity of docks, freight depots and warehouse districts with a large amount of heavy teaming, and they are particularly to be avoided in the vicinity of street car tracks using the old-fashioned flat rail.

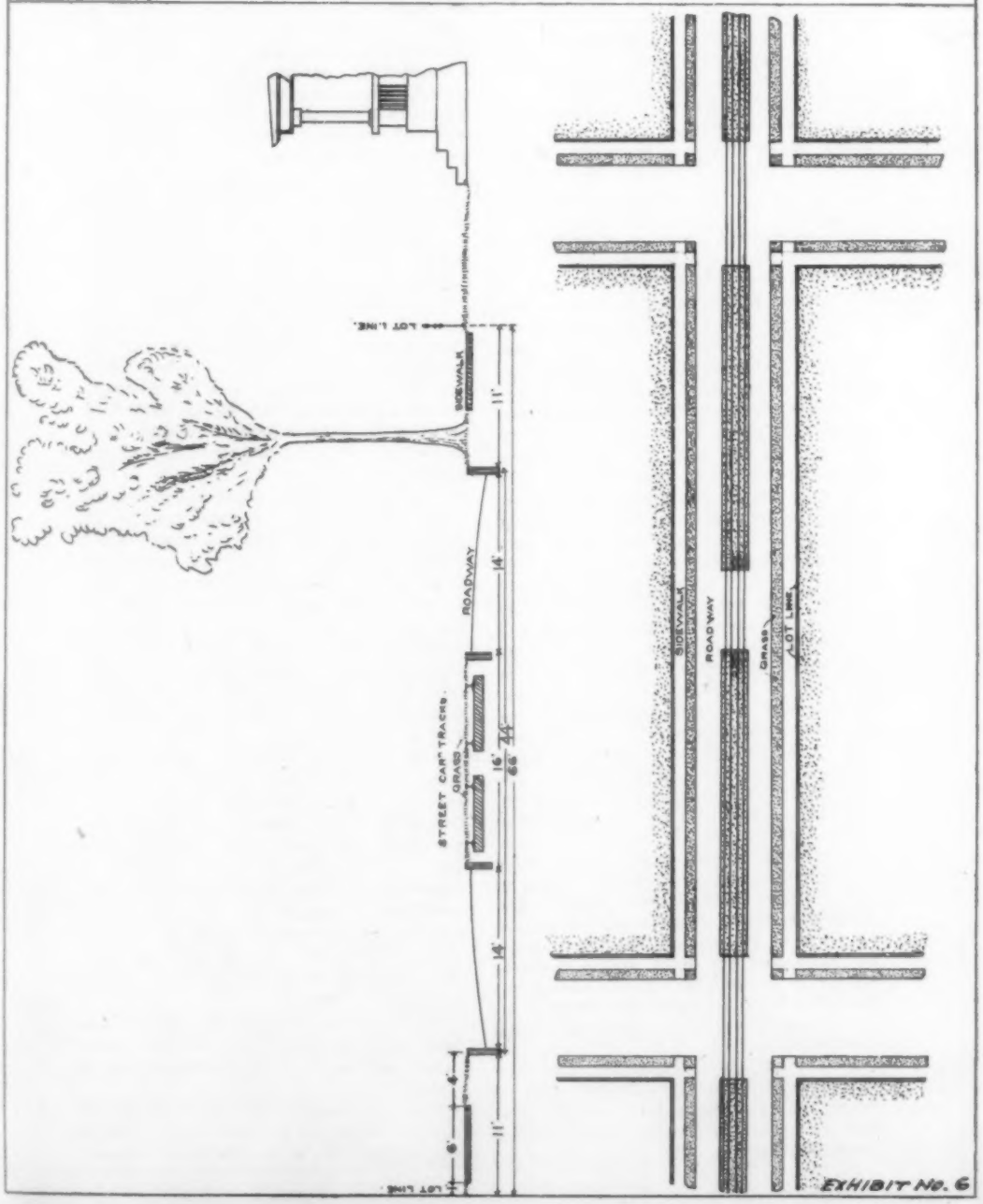
Stone Pavement—Granite and stone block pavements have been the pavements in earliest and most common use. In their recent form they were introduced into this country about 1850. When carefully cut and set granite blocks are laid on solid foundations of concrete, it forms unquestionably the most durable pavement known and has been the standard pavement of most European cities. Such a pavement is less laid than formerly, and the output of granite block has decreased one-half in recent years; asphalt, brick and wood taking their place to a large extent.

It is found that the hardest stones will not necessarily give the best stone pavement, since a very hard stone usually wears smooth and rounded, and becomes slippery. A hard stone may be necessary under very heavy traffic, but under medium traffic a soft stone may give more satisfactory results.

TO ACCOMPANY REPORT OF J.W. ALVORD.

A SUGGESTION
FOR
BEAUTIFYING RESIDENCE STREETS
BY
SODDING BETWEEN CAR TRACKS.

66 FT. ROAD.



Stone pavements, as laid in Chicago, after some wear, become smooth and uneven. They are difficult and expensive to keep clean, and afford a very poor foothold for horses in wet weather, the hoof constantly slipping back until the calks engage a joint. But one of the greatest objections to stone pavements is the noise produced under heavy or medium travel. Such pavement will tend to reduce rents in residence streets which are much traveled, and are objectionable for the same reason in quarters of the city devoted to office buildings, the vicinity of large working populations or industries where quiet is desired.

Some pavements are, therefore, desirable only in streets of the heaviest freight traffic in vicinity of docks, coarse freight warehouses, freight depots and streets where very heavy trucking is necessary, and where noise can be tolerated. They are also a desirable pavement to lay in car tracks, as no other pavement so easily takes up the peculiar shocks, and is so readily repaired, in such situations. They are also well adapted to steep approaches of bridges and viaducts. European cities take more care of the dressing of stone blocks for pavements than is the case in this country, so that the blocks fit more closely together. In many cities, notably in Liverpool, the size of the blocks are reduced to a dimension more suited to the foothold of horses than is the case with the blocks used in Chicago.

Brick pavements are a comparatively old form of pavement which has had a notable revival developed out of the necessities of the central western part of this country, where suitable paving material is deficient over very large areas. A new industry has practically been created in the last fifteen years, until there are now nearly two hundred plants devoted to the manufacture of paving brick. Most of the smaller cities of the Central West early in 1885 to 1890 paved their business streets with brick, and the larger cities following, Philadelphia being in the lead today with over one hundred and thirty-five miles of brick pavement. In all parts of the country the use of brick for residence and light traffic business streets is rapidly increasing, and about as much brick pavement is now in progress as granite block, asphalt and wood combined.

A vast amount of experience has been accumulated upon the manufacture of tough, selected clays into suitable paving brick, and its construction into competent pavements. The pavements of today are a great advance over the earlier experiments, and are very satisfactory for even fairly heavy traffic.

Brick pavements afford a good foothold for horses, and do not become slippery by wear. They are adapted to all grades, and some experiments by Prof. I. O. Baker seem to show that the tractive force required upon them is less than upon asphalt. This must be in comparison with soft asphalt, rich in bitumen, such as is adapted to carry out long-term guarantees. Brick pavements are easily and economically cleaned, and are easily repaired. They may be laid in connection with street car tracks without disadvantage and are not so expensive a pavement as asphalt or granite.

Brick pavements are perhaps not adapted to the heaviest travel, and are not as noiseless a pavement as asphalt or wood, therefore they are adapted to streets described as second-grade business streets, arteries of communication with the country, and possibly, in some cases, well traveled high-class residence streets. They form an excellent material for the pavement of alleyways, courts and squares, and in general are an excellent intermediate pavement as to durability between the granite block of heavy traveled streets and the macadam of country roads.

Wood Block—Wood block pavement, as known in Chicago consists largely of round cedar blocks with the spaces filled with gravel and coal tar. The remains of seven hundred and thirty miles of such pavement still exist upon the streets of the city most of which has been in wretched condition for some time past. The main and inherent defect of circular wood block pavement is the fact that very wide spaces occur at most points between the blocks, the result of which is that the edge of the circle is quickly worn down, and the block becomes rounded or conical in shape. So soon as this result is reached, all the comfort and ease of the pavement is gone, and unfortunately only a moderate amount of travel is necessary to bring the pavement into this condition. Repairs are of little or no avail, as they cannot be made so as to replace the comfort of the original pavement or even lengthen its life to any considerable extent.

The second fatal error of judgment has been that the proper use of wood pavements has been entirely misunderstood in Chicago.

Wood pavement fails either through excessive wear or natural decay. Unless the wooden blocks are of hard material,

TO ACCOMPANY REPORT OF J.W. ALVORD.

A SUGGESTION
FOR
BEAUTIFYING RESIDENCE STREETS
BY
SODDING BETWEEN CAR TRACKS.
80 FT. ROAD.

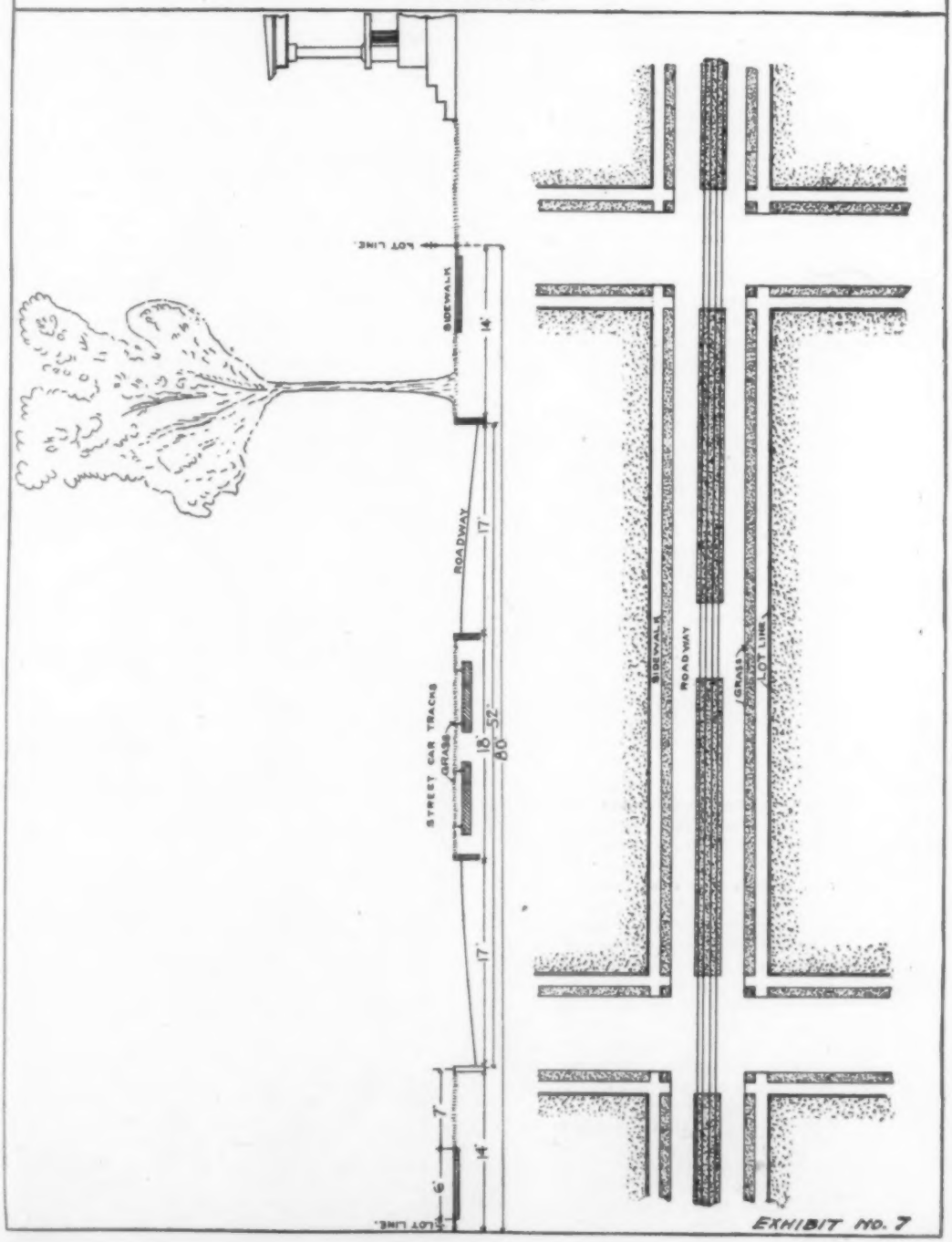


EXHIBIT NO. 7

or are protected by some preservative process, their life is comparatively short in any event. The cedar blocks in use in Chicago, although more durable in wet ground than any other wood, have generally contained from twenty-five to thirty-five per cent of sap, which renders them less durable against decay, and of less strength to resist crushing under traffic than hard wood. But wood pavements in Chicago have been placed in environments entirely unsuited to the peculiar advantages of this form of pavement. Miles and miles of street have been paved with cedar blocks where there was little or no travel to be carried, and the result has been that the pavements have decayed away rather than worn out. Such light traveled streets should always be paved with a material which will not naturally of itself deteriorate, so that the renewals due to the wear of travel only would be necessary, and wooden pavement if used at all, should only be used by laying close fitting wooden blocks upon streets of heavy travel, where the wear will terminate its life before decay sets in, and where its obvious advantages as a smooth, noiseless and comfortable pavement can be most appreciated. This is the way wood is successfully used in London and Paris, where rectangular, close fitting hard wood or creosoted blocks are laid upon a solid bed of concrete, forming a pavement which wears down without rounding the blocks, or even becoming very rough. Such wooden pavements, properly laid, are the favorite high-class pavements abroad, and that, too, under conditions where travel is far more heavy than anything we have in Chicago.

Quite recently the city of Chicago has laid down two samples of creosoted wooden blocks after the London type. One of these is on Michigan-ave., in front of the Auditorium, which was put down in 1901, and is well worth inspection by those interested in this subject. Another sample is to be seen upon the Rush-st. bridge. The life of such pavements in London under heavy traffic has been known to exceed nineteen years, and loans upon them are permitted up to twelve years, and as they are only laid where they will wear out rather than decay, they form an admirable high-class pavement, and are carefully kept in repair and promptly renewed when necessary.

It is probable that the city of Paris has today over seventy-five miles of such pavements in the central streets of heaviest traffic. These have cost, on an average, about $3.47 per square meter, and the cost of maintenance is about 29 cents per square meter per year. The city of London has perhaps over one hundred miles of such pavement in use on its streets whose travel is much greater than anything we know in this country.

The city of Indianapolis has a considerable amount of creosoted wooden block pavement, which has been down some four or five years, and which are said to be very satisfactory. Its use is extending there.

With a few other notable exceptions, wood pavement is at the present time in disrepute in the central States, due to its misuse on such a large scale as has occurred in the past twenty years in Chicago and other Western cities. It is believed by many conservative engineers and city officials that this disrepute is unwarranted, and that wood pavement properly protected and suitably laid on solid foundation has its field of usefulness as a convenient, noiseless and comfortable pavement in streets of heavy travel, where first cost is not the most important factor and where the highest kind of comfort is demanded.

Macadam—Macadam, or broken stone, pavements were originated in England and are universally used as the pavements for country roads. They consist essentially of several layers of crushed stone varying in size from large cubes at the bottom for foundation course, to fine crushed stone as the binder or finishing course. When well wet and rolled with a heavy roller, the entire body is compacted into a more or less solid mass which forms admirable surface for light or infrequent travel.

Macadam pavements are not, strictly speaking, a city pavement, as they are not adapted to the conditions of heavy travel in city streets. Their principal objection is a rapid wear, which produces accumulation of dust, requiring them to be almost constantly sprinkled.

In wet weather the dust is converted into thin pasty mud, all of which is out of place in a city street. Nevertheless, there is a large outlying area in every city when the travel is quite infrequent and the character of the street shades off into the type of country roads. In such localities a macadam street is both desirable and appropriate.

Where travel is so light that pavements commonly subject to decay would have their life terminated for that reason rather than from actual wear, macadam forms a pavement low in first cost, and which may be renewed from time to time without being rebuilt. It is, therefore, the pavement of all others to be used

TO ACCOMPANY REPORT OF J.W. ALVORD.

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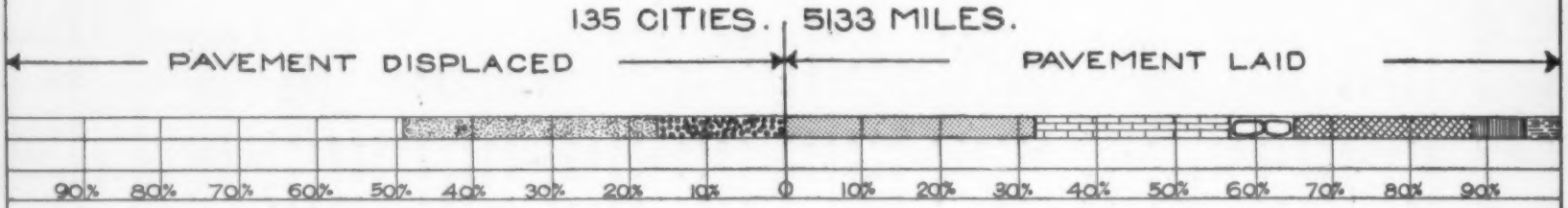
DIAGRAM SHOWING
PAVING TENDENCY IN 135 AMERICAN CITIES.
1890 TO 1901.



GRAVEL
COBBLE STONE
ASPHALT
BRICK
GRANITE
MACADAM
WOOD
MISCELLANEOUS

EXHIBIT NO. 15

where first cost is an important consideration, and in districts where some dust and mud may be tolerated.

The laws of most of the cities of this country are totally unsuited to the use of macadam pavements, because they do not provide funds for adequate maintenance and repair. The result has been that in providing for macadam pavements engineers have been accustomed to providing very thick and expensive pavements in first cost with the expectation of giving them as long a life as possible under ordinary conditions of neglect. The result has been unfavorable to the popularity of macadam, as might be expected. Indeed, no pavement survives criticism under such circumstances.

Much may be learned about the proper construction and maintenance of macadam pavements from the studies of French engineers, who have brought this branch of road-making to a high state of perfection through elaborate tests, reports and long experience.

The Massachusetts Highway Commission has done much in the last four or five years to determine the best kind of stone, proper thickness, and construction of macadam roads, and their reports should be consulted by every student of this subject.

Macadam pavement, then, should be confined to parks, boulevards and the lighter, unfrequented classes of residence streets and the suburban portion of great cities.

Bitulithic Pavement—A new form of pavement, known as bitulithic pavement, or bituminous pavement, has been successfully introduced in the last few years, and is causing great interest among paving officials.

It consists essentially of broken stone so graded as to size that the voids are brought to a minimum. The stones are then heated, and mixed by machinery with a bituminous cement essentially like asphalt. The mixture is hauled to the street, and while still hot spread on the foundation so as to give a uniform thickness and grade and rolled and re-rolled with a heavy steam roller. The pavement appears to have all the elasticity of asphalt, although it does not present so smooth a surface. It gives apparently a better foothold for horses, with, nevertheless, a low tractive resistance. It seems to be adapted to much steeper grades than is asphalt, and it is claimed that it has a much harder wearing surface and a longer life.

None of it, however, has been in use long enough as yet to demonstrate its wearing qualities and durability under heavy traffic, but the promoters state that over 1,500,000 square yards are now laid or under contract in some fifty cities of the United States or Canada.

This pavement is being laid on Delmar-ave., a principal street, leading to the fair grounds in St. Louis, and has been under observation on exceedingly steep grades in Boston, Mass., near the State house, where, after nearly two years' use, it is still unmarked by travel. Such a pavement as this would seem to be a logical outgrowth of experience, and must inevitably have an interesting future.

Summarizing, then, the available pavements for the city of Chicago, we may note that granite block should be reserved for a few of the heavy traffic streets around depots, warehouses and docks, where noise may be tolerated, and between railway tracks. Asphalt may be desirably used upon retail business streets with a large amount of traffic, and wholesale streets with large working populations desiring quiet, streets devoted to office purposes, public squares, and the vicinity of institutions and hospitals, high-class residence streets with considerable traffic, and medium residence streets well traveled.

Wooden block pavement, of the London and Paris type, laid on solid foundations, might be desirably used wherever asphalt is used, with a restriction that it be not laid upon streets not heavily traveled, where its life might be terminated by decay rather than by use.

Brick pavements are desirable for second-grade retail business streets, streets with car tracks, arteries of traffic where some degree of economy is desired, and residence streets where the taxpayers do not object to the noise.

Diagram Showing
PER CAPITA EXPENDITURE UPON STREETS
20 Largest American Cities —

For last Fiscal Year Preceding Sept 1902 as given by Bulletin No. 42. U.S. Dept. Labor

Full Line Indicates Expenditure on Construction
Broken " " " in Cleaning & Sprinkling

$400
$300
$200
$100
$90
$80
$70
$60
$50
$40
$30
$20
$10

BOSTON. Income per Capita $80.00
WASHINGTON. Income per Capita $30.30
PITTSBURG. Income per Capita $27.60
NEW YORK. Income per Capita $33.20
BALTIMORE Income per Capita $17.40
NEWARK Income per Capita $24.40
PHILADELPHIA Income per Capita $13.70
MILWAUKEE Income per Capita $14.30
CLEVELAND Income per Capita $18.10
BUFFALO Income per Capita $16.90
MINNEAPOLIS Income per Capita $17.60
LOUISVILLE Income per Capita $16.00
CINCINNATI Income per Capita $24.30
ST. LOUIS Income per Capita $20.98
JERSEY CITY Income per Capita $22.60
CHICAGO Income per Capita $17.30
PROVIDENCE Income per Capita $32.20
DETROIT Income per Capita $18.30
NEW ORLEANS Income per Capita $18.20
SAN FRANCISCO Income per Capita $27.30

EXHIBIT No. 19.

EDITORIAL COMMENT

The Demand for High Class Construction With Cement Blocks.

Management of Municipal Water Works.

Municipal Ownership of Plants for Electric Lighting.

THE DEMAND FOR HIGH CLASS CONSTRUCTION WITH CEMENT BLOCKS.

The following extract from a letter written by a manufacturer of cement block machines puts in excellent form the points which this magazine has been trying to make in several recent articles. The necessity for first-class material and work if the new method of concrete block construction is to be permanently successful, is clearly stated. The interested investor cannot be too strongly warned that there are good and bad blocks on the market, and that the possession of a good machine by a block manufacturer is not sufficient guaranty of a good block. The extract is as follows:

"The cement block machinery business is in a state of chaos at present, as every man that can think up a method of making hollow blocks and can beg, borrow or steal cash enough to get one mold or machine made is rushing into the business. The catalogues which give directions for the making of the blocks are enough to make a man's hair stand on end. The result will be that there is going to be as much prejudice against this industry as there is enthusiasm now. The process of building houses from this material is not understood yet, and until architects and men with a scientific training come to the front there will not be much real progress. A building made of poorly manufactured and cured blocks and laid up in a hodge-podge manner strikes a blow at the successful use of this material, which it will take considerable time to overcome. We think that several articles in the magazine are much to the point on this subject."

The outlook is not quite so gloomy as our correspondent seems to think. His letter contains one ray of hope in the statement elsewhere in it that he has many answers to his advertisement from professional men. This shows that the men with scientific training are beginning to take an interest in the subject and when they do take hold of it they will "come to the front." Other cheering features are the advertisement of forthcoming books upon the subject, in continuation of the treatment given in Hagloch's "Art Stone," reviewed elsewhere in this number, and the offer of articles by architect for the magazine which will probably appear very soon.

When the architects take up concrete construction as enthusiastically as the engineers have already done, the evil effects of bad materials and bad workmanship by ignorant and careless block manufacturers will lose their influence and the necessity of making a careful choice of machine, material and workmen will be more often recognized. Undoubtedly the failures already made and yet to be made will have their effect in retarding the development of the industry, but it has now been proven beyond a doubt that there are good machines that make good blocks w... which good buildings have been constructed. When, in addition to these strong points, it is shown that the structures can be made good in their architectural features, the development in new lines will be so rapid that the present doubt of the future will appear ridiculous. This is the reason for the call this magazine is making upon the attention of the architects, that they may recognize the many advantages of the new form of building material and guide its development in the right way. There is much good business as well as great opportunity for professional advancement for those who take hold of the matter promptly and in a progressive spirit.

MANAGEMENT OF MUNICIPAL WATER WORKS.

A correspondent asks for some suggestions regarding the management of a municipal water plant, and in the Question Department this month will be found a list of articles upon various phases of the subject, which have appeared in municipal engineering from time to time.

TO ACCOMPANY REPORT OF J.W. ALVORD.

DIAGRAM
SHOWING COMPARATIVE TRAFFIC
IN TONS PER DAY PER FOOT WIDTH OF STREET IN PRINCIPAL CITIES.

ADAPTED FROM PAPER BY F.J. GREEN T. AM. SEC. C.E. VOL. 15. P. 123.

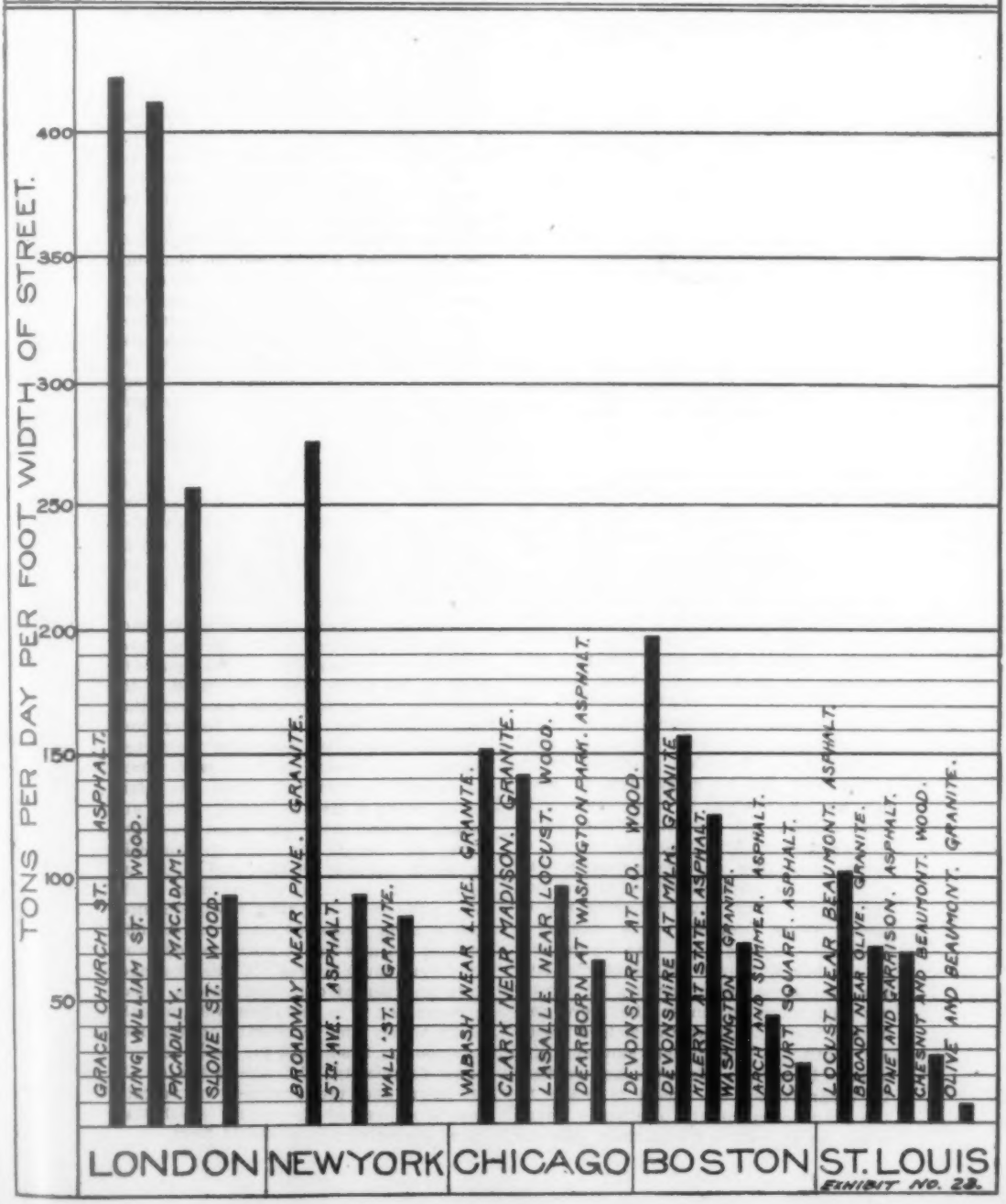


EXHIBIT NO. 28.

In short, the suggestions made in all the articles referred to will be followed substantially if the water works can be put in the hands of men who will manage them in the same way that they would manage their own large affairs.

Ordinary business principles demand furnishing the best service possible and charging for it what the service is worth, with due regard to the effect upon the business of reducing rates in case the service is worth much more than it costs to render it, and, in almost every business, with regard to the possibilities of the development of competition. In a public service industry the question of competition is ordinarily put out of the way, and in return for the monopoly granted by the city, the company should submit to reasonable regulation of its rates provided they are not reduced below a reasonable cost of first-class service. In case of municipal ownership the profits should be so reduced that the surplus will simply insure ample funds for extensions and renewals.

The payment of political debts by favors in the way of special contracts for water, employment in the department without reference to fitness, special contracts for supplies at high prices and the like have their analogies in private corporations, but are far from good business practice. The principal point to make in beginning the operation of a municipal plant is therefore to secure the appointment of trustees or commissioners who are as far removed from the political field as possible and at the same time secure live, progressive, careful, honest business men who can and will manage the plant on the best business principles. If this board can then be made permanently independent of political changes, the plant is in as good hands as any first-class business corporation and can be safely left to work out its own detail of operation. In some cases it has proven sufficient to fix the number of commissioners at five or seven, according to circumstances, and to have the term of office of but one expire each year, thus requiring five or seven years ordinarily to make a complete change in the personnel of the board, unless the pernicious custom of resignation on change of administration steps in under the more pernicious motto that "to the victors belong the spoils" to nullify this salutary provision. In several cases the appointment to vacancies on the board is made by the judge of a county or district court, when he is well removed from the demands of the city politicians. This method of appointment apparently produces very satisfactory results, especially when the incumbents are reappointed so long as they keep their interest in the proper management of the plant and attend promptly and carefully to the business.

Merit can, under these circumstances, be made the only requisite for employment in the department and good men can safely depend upon continuance in place as long as they perform their duties to the best of their ability. This should insure efficient and economical service. In large systems some form of civil service may be desirable, but this is not necessary in the smaller plants, provided the board of commissioners selects its superintendent and engineer, whether in one or two persons, on the right principle.

The commissioners, with possibly one or two exceptions, will be men not acquainted with technical detail, but should be good business managers, broad enough and intelligent enough to be able to look at all sides of the questions which arise and to understand the results to be obtained by their professional advisers and to judge of the value of the methods proposed for obtaining them. It will be necessary, therefore, for them to select a man, or two men if the plant is large enough to require two, who are fully equipped with ability, education and experience to take care of all the details of the business department and to design and carry out the additions, changes and repairs in all parts of the system as the need for them arises.

Perhaps the most common error made in the management of a municipal water plant is in the selection of the man who is to be the really responsible head of the business. It is too often assumed that some clever local man can be depended upon to develop the necessary characteristics, and a salary is fixed with which he would be satisfied, when the plant really needs a man of broader view and larger attainments, who must be found elsewhere than in the home city and who is worth perhaps double the salary offered. The selection of this man is the first problem in a system newly acquired and it must be solved when the commissioners are new in the business and probably very much at sea. A mistake made here and persisted in has serious consequences and it is therefore well to make haste slowly and to operate openly upon a temporary basis until the board acquires some familiarity with the needs of the situation and the qualities and attainments, as well as the salary, which their chief executive officer should have.

When this appointment is properly made the department will be able to solve its own problems. The articles referred to are then to be taken as suggestions from the experience of others which will be modified to suit the local conditions.

MUNICIPAL OWNERSHIP OF PLANTS FOR ELECTRIC LIGHTING.

The city of Wausau, Wis., under the advice of Engineer Jacob Cloos, of Milwaukee, is beginning the operation of a contract for electric lighting, which is based on a principle which has been favorably commented upon by this magazine in the past.

The city erects the poles and wires and furnishes and operates the lamps for its street lighting system and purchases the current for the lights from a private company, which operates the central electric generating station.

The present contract for lighting the city at $80 per lamp per year expires in August. The Wausau Electric Company proposed on July 5 to renew the contract at $45 a year for 420-watt-hour lamps on 2,190-hour schedule, or $55 on the present all-night schedule, or to supply current only on the basis of 2.8 cents per kilowatt-hour on the moonlight schedule, or 2.3 cents on the all-night schedule, the city to furnish and operate the street system from switch-board to lamps. The latter offer was accepted and the current is estimated to cost $29.40 per lamp per annum.

Bids for the necessary construction have been received and accepted. The poles, lines, wiring and wiring devices will cost $8,140; the arc lamps, 125 in number, will cost $2,500, and the switch-board will cost $600, making a total of $11,240.

It is estimated by the engineer that the cost of maintenance on the all-night schedule, with this plant will be $15.60 per lamp per year, making the total cost $45 per lamp per year. This estimate indicates a saving of $10 a lamp over the bid of the company for the entire service, and a saving of $35 a year over the price paid under the last contract.

It has always been difficult to secure reasonable competition for electric lighting contracts when they come up for renewal, the company in the field having the advantage of the possession of a complete plant in running order. It has been suggested several times that it would be advantageous to the city to own the street plant and to give contracts for furnishing current and maintaining and operating the street plant, thus giving every electric power station in the city equal opportunity to bid upon contracts and making it possible for new companies to bid with a minimum of construction, directly convertible at any time to other uses if the lighting contract is taken away.

Wausau carries this suggestion one step farther and will not only own its street lighting plant outside the power station, but will operate and maintain it. The operations of the city under this proposition will be watched with interest, and if it is successful in reducing the cost for light to $45 a year on an all-night schedule other cities will be likely to follow its lead. There are some disadvantages in such a contract and it is probable that they will develop during the year. It is believed by the advisers of the city of Wausau that the advantages outweigh the disadvantages to the extent shown by the estimates. A year's operation under the new contract will show whether the estimates are correct.

THE QUESTION DEPARTMENT

CREOSOTED WOODEN BLOCK PAVEMENTS.

I would thank you to let me know your experience with creosoted or kreodone block. C. T., ——, Mich.

The subject of creosoted wooden block pavements has been quite fully considered in Municipal Engineering during the last six or eight years, including those laid with plain creosoted blocks, with blocks filled with kreodone oil and with blocks treated by the creo-resinate process. The following are some of the principal articles which have appeared:

"Pavements of Indianapolis," vol. xxv, p. 314.

"Wood Paving Specifications in Greater New York," vol. xxv., p. 328.

"The Development of the Kreodone Block Pavement," vol. xxv, p. 333.

The second and third articles above, while written by advocates of two special forms of wooden block pavement treated with preservatives, are scientific in their construction, and the latter especially gives a history of the recent developments in creosoted wooden block pavements and the difficulties which have been met and the defects which have shown themselves. The two articles give methods in which most if not all of these difficulties and defects have been overcome.

A list of a few of the articles which have appeared in this magazine will be found in the July number, vol. xxvii, p. 23. In vol. xxi, p. 73, is a statement of the general opinion regarding this form of street paving, given in this department of the magazine in response to a question. This opinion is stated to be distinctly favorable and the reasons for it are briefly given. The writer has seen no reason to change this statement in the time since it was made.

ASPHALT ROCK CRUSHERS.

I beg to ask if you would kindly give us information as to machines for breaking rock asphalt blocks. We are desirous of knowing what methods are employed in the United States for reducing the size of blocks after they have been blasted, on the spot, so as to avoid the waste caused by repeated blasting. We are interested mainly in Sicilian rock asphalte, which consists of limestone mainly with 12 per cent bitumen.

C. C. STEVENSON.
British Vice-Consul, Hanover, Germany.

The rock asphalt used in the United States for paving purposes is practically all of its bituminous sandstone, which is much softer and more easily pulverized than bituminous limestone. In some instances it scarcely requires blasting from the quarry face. The fragments of rock resulting from a blast are carried to crushing machinery, the type which is most successful being probably the crushing rolls which are corrugated or fluted. The manufacturers of ore and rock crushers whose names are given in the "Business Directory" published in each number of Municipal Engineering under the heading, "Crushers, Rock and Ore," will be able to recommend the best form of their machinery for the rock asphalt referred to.

SPECIFIC HEAT OF ASPHALT.

In your Question Department of July issue the specific heat of asphalt is discussed. Would you explain the unit of heat with reference to asphalt and the bearing that specific heat may have with relation to the roofing or paving trade?

HOUSTON BROTHERS COMPANY,
Pittsburg, Pa.

The specific heat of a substance is the ratio of the amount of heat necessary to raise a certain mass of a substance one degree in temperature to the amount of heat necessary to raise an equal mass of water one degree in temperature, the water being at its maximum density. It takes one British thermal unit to raise one pound of water one degree in temperature. According to the results given in the July number it would require 0.350 B. T. U. to raise one pound of refined Trinidad asphalt the same amount. The only value which this figure has for the roofing trade which the writer sees is with reference to the amount of heat necessary to apply to a mass of asphalt to melt it for the purpose of mixing and applying. Practically it is probably true that the difference in specific heat of different roofing materials is not sufficient

to make it worth while to take any account of it in comparing the economy of the various kinds of material used.

MAKERS OF ASPHALT BLOCKS.

Who makes machinery for making asphalt blocks in the United States and in Europe? P. D. B., Havana, Cuba.

Asphalt paving blocks are made by two or three firms in this country (see "Business Directory" under heading "Asphalt Blocks") under patents on machinery and product owned, it is said, by the International Block Company of Baltimore, Md.

If machinery for compressing asphalt into blocks for shipment is desired, information can be obtained through asphalt mastic importers, whose names will be found in the "Business Directory" printed in each number of Municipal Engineering under the headings "Asphalt and "Asphalt Importers."

CONSTRUCTION OF MACADAM STREET.

1. What parts of an old macadam street are suitable to build a macadam foundation for brick paving? Does the fine sand like crushed rock that is in the old macadam, if used with coarser material injure the foundation for brick paving?

2. Will the court sustain an incompetent man as an inspector?

3. Is a fifteen-ton roller too heavy to roll a six-inch macadam when it is laid on wet clay?

SUBSCRIBER, Sterling, Ill.

1. If the macadam street is to be improved by relaying with brick, it is best to leave the macadam in place with as little disturbance as possible. It then forms an ideal foundation for a brick pavement for light travel. If the grade of the street is changed it will of course be necessary to disturb the macadam surface and thus injure the foundation. If the grade of the street is not changed it may still be necessary to change the surface of the street. Thus a macadam street requires a cross section somewhat higher in the middle than does a brick street. The reduction in the curve of the cross section may be made by taking off some of the crown from the center of the street, thus reducing the thickness of the old macadam foundation; or it may be made by filling up the gutters and the flanks of the roadway; or by both methods together. Again, the center of the old macadam street may have worn down so that the gutters would require excavation or the crown would require filling. The general principle upon which the work should be done is to disturb the original macadam as little as possible with due regard to the permanent surface of the brick pavement and its relations to its surroundings.

If the macadam surface is to be taken up entirely and laid elsewhere the question of the suitability of the material must be settled on inspection by an expert in such matters. The material may be in a condition which is good or bad and any decision based on its original condition must be modified by inspection of its present condition.

2. The second question is ambiguous. An inspector appointed by the proper authority will probably not be removed by a court except upon the most overwhelming evidence of incompetence and neglect of duty by the city officials and the process would probably be long and expensive. If the question means to ask what would be the attitude of the court in permitting assessments for defective work passed by an incompetent inspector, it may be said that the decisions which have been made in such cases have been in general on the side of equity, the circumstances of each particular case influencing the decision. The courts do, however, in the absence of evidence of fraud, accept the approval of the finished work by the proper municipal authority responsible for the work as final evidence of its sufficiency. Such matters as the employment of inspectors are matters for the exercise of judgment of such municipal officials, whose honest discharge of such duties will not often be interfered with by the court.

3. The third question can only be answered correctly on inspection of the work. It very often happens that a 15-ton roller is too heavy for the work described. Better compression can often be obtained with a lighter roller run oftener over the street. Some of the lighter rollers have a greater compressive weight per linear inch of roller than the heavy machines, or can be loaded to produce this result.

BOOKS ON BRICK STREET PAVING.

Kindly advise us if you have a book pertaining to brick street paving, giving a thorough elementary treatise on the plans and modus operandi for its installment.

ELLIOTT ELECTRIC BLUE PRINT CO., Pittsburg, Pa.

Perhaps the best treatise on brick pavement in book form will be found in the chapters on this subject in Baker's

"Roads and Pavements" ($5). Good chapters will also be found in Tillson's "Streets and Street Paving Materials" ($4) and in Byrne's "Highways" ($5). Judson's "City Roads and Pavements" ($2) has a short but very practical chapter on the subject. Any of these books will be sent postpaid by Municipal Engineering Company upon receipt of the prices given.

DESCRIPTIONS OF CHICAGO BRIDGES.

Would you kindly advise me where I can get good descriptions of the different bridges over the Chicago River, especially the latest?

H. S., Chicago, Ill.

Short illustrated descriptions will be found in the annual reports of the City Engineer of Chicago, with an occasional longer description such as that of the Clybourn-place bridge in the report for 1900. Several descriptions of Chicago bridges have appeared in the technical weeklies. The secretary of the Western Society of Engineers, Monadnock Block, doubtless has there on file and would permit engineers to examine them.

NAMES OF DEEP WELL DRILLERS.

Can you give me the names of one or more well drillers, as our city desires to have a deep well sunk?

W. W. D., City Clerk, ——, Iowa.

In "Hendricks' Directory" ($6) will be found a long list of well drillers in all parts of the United States from which those who would be willing to take a contract in the State of Iowa can be selected by correspondence.

USE OF ALUM IN PURIFYING WATER.

We desire information as to the names of cities using alum as precipitant in connection with mechanical filters, also the names of parties building and installing such plants.

SUPERIOR CHEMICAL CO.,
Joliet, Ill

The "Muncipal Year Book" ($3) gives a list of nearly 200 cities and towns using mechanical filtration for their water supplies. It is safe to say that more than 80 per cent of these plants use alum as a coagulant. There are also many private plants using alum as precipitant. On reference to the "Business Directory" in each number of Municipal Engineering under the heading "Filtration Plants" the name of William B. Scaife & Sons of Pittsburg, Pa., will be found, and, information concerning the many private and public plants constructed by them can doubtless be obtained on application to them. Other manufacturers of mechanical filtration plants are the New York Continental Jewell Filtration Company and Pittsburg Filter Manufacturing Company.

MUNICIPAL OWNERSHIP OF WATER WORKS.

The city of Waterloo, Ia., is considering the advisability of owning its water system and a committee appointed by the city council to investigate municipal ownership is endeavoring to secure facts regarding the experience of other cities that have municipal plants. Can you advise me how I may obtain a list of cities of 15,000 to 20,000 people in the Upper Mississippi Valley that have municipal water plants? Can you give me the name and address of any publication that would be of value to the committee?

E. E. PEEK, Waterloo, Iowa.

The following cities of the size and in the district named are reported in the "Municipal Year Book" ($3) as having municipal water works: Decatur, Ill.; Anderson, Ind.; Winona, Minn.; Rock Island, Ill.; Madison, Wis.; Galesburg, Ill.; Lafayette, Ind.; Marion, Ind.; Moline, Ill.; Lansing, Mich.; Logansport, Ind.; Jacksonville, Ill.

The question of municipal ownership of water works has been discussed frequently in Municipal Engineering. Some of the articles are listed in the answer to the question on the "Management of a Municipal Water Plant" elsewhere in this department this month. A larger list is given in vol. xxiii, p. 104. Articles which have appeared since the last list was printed are as follows: "Massachusetts Plan for Municipal Ownership Tested at Holyoke," vol. xxiii, p. 187; "Municipal Ownership at Santa Clara, Cal., vol. xxiii, p. 190.

COST OF CAST IRON PIPE.

I want to learn the price of cast iron pipe for water mains, from 16-inch to 4-inch inclusive, preparatory to enlarging our present water system, owned by the city. We want to equip for a population of 20,000. E. R., Santa Rosa, C.

The latest quotations at hand for water pipe in New York City are $28 a ton for 6 to 10-inch pipe and $27 for 12-inch and over; in Chicago, 4-inch, $25.50; 6-inch and up, $24.50. Ordinary water pipe weighs as follows: 4-inch, 260 pounds; 6-inch, 420 pounds; 8-inch, 600 pounds; 10-inch, 815 pounds; 12-inch, 1,050 pounds; 16-inch, 1,615 pounds per 12-foot lengths.

MANAGEMENT OF A MUNICIPAL WATER PLANT.

As this city is about to purchase the water works plant, what, in your opinion, would be the best method of operating the same in regard to management?

L. M. J., Baraboo, Wis.

Several phases of this question have been discussed in Municipal Engineering in the past. Among the articles to which reference may be made are the following:

"Efficiency in Municipal Management." vol. xxv, p. 85.

"Regulations for the Use of Water in Small Plants," vol. xxi, p. 63.

"Efficient Management and Maintenance of Water Works," vol. xx, p. 295.

"How Politics Detrimentally Affects Municipal Management," vol. xix. p. 32.

"The City Should Pay for Public Uses of Water," vol. xviii, p. 333.

"Management of a Municipal Water Works," vol. xvi, p. 196.

"Municipal Ownership and Permanence in Management," vol. xiii, p. 357.

"Appointment of Water Works Commissioners by District Court," vol xiii, p 307.

"The Financial Management of Water Works," vol. xiii, p. 207; vol. xi, p. 210.

Some further discussion of the subject will be found in the editorial department in this number.

INFORMATION ON UNDERGROUND WATER SUPPLIES.

Can you give me the name of some valuable paper or article on artesian wells and underground water supplies?

J. B. M'CRAY, Statesboro, Ga.

The most detailed information about underground water will be found in Series O of the "Water Supply and Irrigation Papers," published by the U. S. Geological Survey at Washington, D. C. Twenty-two of these papers have been issued in the years from 1879 to 1904. There are also seven papers in the 17th, 18th and 19th annual reports of the Survey which are devoted to the same subject. For a very excellent general discussion of the subject of underground waters and methods of utilizing them refer to Turneaure's "Public Water Supplies" ($5), in the various chapters and parts of chapters treating the various phases of the subject.

TREE ROOTS IN SEWERS.

This town has lines of sewers laid with eight-inch vitrified clay pipes in streets heavily shaded with elm trees, the roots of which have in several places penetrated the pipes and obstructed them. It is thought the trouble will increase. Can anything be done to save the sewers and at the same time retain the elm shade trees, from which the citizens are very loath to part?

E. V. ZOLLER,
Member Board of Public Works, Tarboro, N. C.

The problem of getting and keeping roots out of sewers has been considered frequently in this department. Devices for cutting roots out of sewers are described in vol. xviii, pp. 109, 171; vol. xxii, pp. 155, 303; vol. xxv, p. 89, the latter describing the apparatus devised by Thomas Strouse of Roland Park, Md. Tight sewer joints are the only certain preventive of roots in sewers. The method of making them is described in vol. xviii, pp. 109, 243 and vol. xxiv, p. 431. One city engineer proposes to put a quantity of salt about each joint so that the roots cannot reach the sewer, the salt preventing the growth of the roots where it lies. The permanence of this method would depend upon the amount of water likely to flow through, dissolve the salt and carry it off. With sewers already laid an occasional cleaning of the sewers with a machine like that of Mr. Strouse's without waiting for actual stoppage should be successful and fairly reasonable in cost.

CEMENT SEWER PIPE.

I would like your suggestions in regard to the use of cement pipe for sewer purposes. We are manufacturing a very fine line of sewer tile out of cement, but have all kinds of objections to meet among the people. Some say that a cement tile will leak and not carry the odors away and that cement pipe are not as smooth as clay tile and would thus clog the pipe quickly.

O. JOHNSON,
Brookings, S. D.

The use of cement and concrete for building sewers, made in place, formed of blocks, and laid with cement pipe is discussed in Municipal Engineering, vol. xxiii, pp. 19, 20, 93 and 169. From all or these articles information regarding the objections mentioned can be obtained.

A poorly made cement tile might be porous enough to let the water through it when new, but this water would be well strained of the solid matter in it, and, if not disturbed, this solid matter would finally close the pores in the cement and make the pipe water tight. Such a pipe would also let in ground water and would not be sealed against its entrance so soon. This objection to the porosity of the pipe is lessened as the quality of the pipe is improved and would be inappreciable in a cement pipe made strong enough to stand the maximum pressure which the earth in a deep trench could put on it. This can be

tested readily by tightly closing the ends of a cement pipe so that no leakage will occur here and making observations to see whether water seeps through the cement wall of the pipe. If desired the ends can be closed tightly enough so that the water can be put under pressure, in which case there will be more probability of the water passing through.

A brick sewer plastered with cement will carry a considerably larger quantity of sewage than the bare brick sewer. The cement tile are doubtless smoother than the plastering of such a brick sewer, and, except for retardation of flow at poorly made joints, would show still larger increase in flow so far as roughness of the surface is concerned. A smooth vitrified tile offers less resistance to the flow of sewage than a smooth cement sewer, but a slightly rough vitrified tile may easily offer more resistance. In either case the difference is not sufficient to rule out one material in favor of the other, and it will be found that very many stoppages are due to roughness at joints, which may well be greater in vitrified than in cement tile, on account of the greater uniformity in form of the latter.

Other points of criticism are considered in the articles above referred to.

BOOKS ON PORTLAND CEMENT CONCRETE.

We will be pleased if you will send us list of books published or handled by you relating to uses of Portland cement in concrete construction work, etc.

VULCANITE PORTLAND CEMENT CO., New York City.

The most complete and practical book on this subject is the "Handbook for Cement Users" ($3). Spalding's "Hydraulic Cement" ($2), treats of cement rather than the practice in using it. Three good English books are Butler's "Portland Cement" ($6), Potter's "Concrete" ($3) and Redgrave's "Calcareous Cements" ($2.75 net). Mensch's "Reinforced Concrete Constructions" ($2), Hagloch's "Art Stone" ($1.50) and "Concrete Dwelling Houses" ($2.50) are restricted to the uses of Portland cement in their respective fields.

BES. CONCRETE BLOCK MACHINE—BOOKS ON CEMENT WORK.

I wish to ask you which is the best and most reliable system of concrete building block on the market at present. I want nothing that is not strictly first-class and will not answer all the requirements of the most scrupulous architects. Please cite me to some published authority on cement work generally, including building blocks, that will be of assistance to me in the work.

F. H., New Orleans, La.

Advice upon this question must be based upon full knowledge of the local conditions to be met, and after choice of class of machines is made, personal preferences and individual peculiarities of machines and their adaptation to these conditions must be taken into consideration. The general principles upon which a machine should be selected are given in an article on "Concrete Block Manufacture" in vol. xxvi, p. 389, June, 1904. Other articles that will be of assistance will be found in nearly every number of Municipal Engineering for the past two years, including descriptions of all the prominent machines. Special attention is called to articles on "Concrete Block Architecture" in the May and July numbers, and to descriptions of machines in those numbers and in this number.

Reference may be made to the answer to question entitled "Books on Portland Cement Construction," elsewhere in this number, the "Handbook for Cement Users," with Potter's and Hagloch's books being of special practical value, and the last-named paying particular attention to cement blocks.

REQUIRED SIZE OF HOLLOW CONCRETE BLOCKS FOR WALLS OF BUILDINGS.

What thickness of hollow concrete blocks is used for walls of one and two story buildings?

How does the concrete block compare with brick and stone walls for strength and durability?

SUBSCRIBER,
Havre, Mont.

It seems to be generally assumed that a hollow concrete block will replace a brick wall of the same thickness, but this is only approximately true. Some blocks are certainly stronger than others, on account of differences in proportions of materials, in methods of manufacture and in pressure or thoroughness of tamping. Some blocks have larger proportions of hollow space than others, and some have these spaces better distributed. Thus far it has been assumed that there is sufficient excess of strength in the concrete blocks to permit the ignoring of all these differences, and so long as the constructions are restricted to one or two story buildings this is probably true for blocks made with care and with good materials and mixtures of proper proportions. As the art of making blocks is developed, more attention must be paid to these points.

Very few tests have been made of hollow blocks to determine their compressive strength and few of these have been published. The tests of Palmer blocks show that a 10-inch block has an excess of strength over a 13-inch brick wall. This would indicate that, under ordinary circumstances the assumption of thickness of concrete blocks equal to brick walls replaced by them is safe. Not all blocks are equally strong, whether from the use of leaner concrete or less satisfactory methods of manufacture. Durability depends also upon materials and proportions as well as method of manufacture. Well made blocks of good material in proper proportions are more durable than any building materials except the hardest and most expensive stone, and are the most durable when their greater ability to resist fire is considered. Cheap blocks may easily be no better than soft brick.

In short, there is as much difference in strength and durability of concrete blocks as there is in any other building material and equal care must be taken in selecting them to secure the results desired.

COST OF CONCRETE STREET CROSSINGS.

Will you please give me the price usually paid for building cement street crossings, where a five-year guarantee is given with bond? P. M., East Bradley, Pa.

The prices quoted vary widely according to the local specifications and conditions, as well as prices of materials and labor. They lie mainly between 15 and 25 cents a square foot. Perhaps some other contractors among our readers will send us the results of their experience and give the price at which they find it possible to do good work of this character.

EMPIRE OR IMPERIAL IMPORTED CEMENT.

Can you give us any information on either Empire or Imperial cement, we are not quite sure which is the correct name? We are under the impression that it is an imported cement used for wall plastering purposes. We desire to learn if possible something more about it and if of foreign manufacture where the same can be obtained in this country. C. P. F.,
Allegheny, Pa.

The "Directory of American Cement Industries" ($5) gives the Empire brand of Portland cement as manufactured at Warners, N. Y., and two brands of Imperial, one manufactured by the Imperial Portland Cement Company, 421 Chestnut-st., Philadelphia, Pa., and another by the Imperial Cement Company, Owen Sound, Ont. We are not familiar with any other cements under these names.

Can our readers give us any information regarding cements or plasters sold under the names mentioned?

COST OF CEMENT PLANT.

Myself and associates are the owners of some quite extensive holdings in cement and lime rock and we are debating in our own minds whether it will pay to develop them. First of all we wish to ascertain approximately what a small modern plant will cost, say with a capacity of 250 barrels a day. Will you kindly refer us to some one who can tell us? H. M. T.,
Spokane, Wash.

If reference is made to the "Business Directory," printed in each number of Municipal Engineering, under the heading "Cement Plant Designers" the names of persons who can give full answer to the questions asked will be found. The descriptions of cement plants given in the "Directory of American Cement Industries," ($5), the capitalization of Cement Companies and the headings under the department of "Machinery and Supplies for Cement Plants," give a good idea of the various machinery needed in a cement plant and of the capital thought necessary to operate one successfully.

MAKING CEMENT CASTINGS.

How can I make a cement casting that will be clean and finished when it comes out of the mold? I am obliged to put a finishing coat on, which is very troublesome when you have to go over molding. I finish with a tapioca brush and can imitate stone pretty well, but they are not drying out regularly.

Is there any kind of paint that I could go over with that would withstand all kinds of weather so as to make them look alike? N. M., Bally, Pa.

Without fuller description of process used it is difficult to say what is the exact difficulty in this case. Possibly the mold, if of wood, absorbs too much water, if the wet process is used, or is not sufficiently smooth if the dry process is used. Perhaps the trouble is with the mixture or with the materials of which it is made. Perhaps the blocks are not sprinkled often enough while curing and they dry unevenly on this account.

There are many articles in Municipal Engineering in the past three years describing processes and machines for making artificial stone. Practically all the

processes and machines have been described within the period mentioned. Hagloch's "Art Stone" ($1.50), reviewed elsewhere, gives many practical hints on the making of artificial stone.

It is best to make blocks of uniform materials, thoroughly mixed before the water is added, and if this mixture is uniformly treated and is not stained by mold or in storage and is properly wet during curing, uniform color will result. Change in cement, in sand, or in gravel, and even great change in amount of water will affect the color of blocks enough to produce a noticeable departure from uniformity. A concrete block wall can be painted in the same way as a brick wall and with the same materials, thus producing uniformity in color but changing materially the effect produced by the method of construction.

WILL A PORTLAND CEMENT TANK HOLD GASOLINE?

I have a gasoline gas tank which leaks. I thought if I would build a brick wall around, say about 2 or 3 inches from the tank and then fill the space between with good Portland cement it would hold the gasoline. In short, will Portland cement hold gasoline? J.W.

Port Washington, Wis.

It would seem to one not familiar with the apparatus in use that the tank could be repaired, painted or calked to make it gas tight at less expense than the cement wall would require. If neat cement is used and it is protected from temperature changes so that it will not crack, the proposed thickness should be practically gas tight, but there are too many doubtful places in the process of putting it in place to guarantee this. Cement tanks are used frequently to contain oil where evaporation is not so serious a matter as it is with a light oil, such as gasoline.

HOW TO BUILD CONCRETE CULVERTS.

I have four or five culverts to put in for the county, to be constructed of concrete. They are to be 20 feet long, 5 feet wide and 5 feet high and arched. Would you please inform me of the best plan to construct them and how the concrete should be mixed and how thick the walls should be and how the arch should be made.

W. J. G., Tipton, Ia.

What information it is possible to give without knowing the special circumstances of the case will be found in the "Handbook for Cement Users" ($3) and in several articles in Municipal Engineering. See the answer to the question on "Concrete Culverts" elsewhere in this number for reference to such articles.

CEMENT WALKS—CEMENT TESTS.

In cement sidewalk and curb construction I wish to know if it is not considered necessary to keep the work covered either with sand or canvas and in a damp condition for some time, especially in hot weather. I would like to know about how long it is usual to keep walks covered.

I wish also to know if wet concrete is not considered stronger and better than dry concrete.

Could you direct me to where I could get molds for making tests of cement?

C. M. T., Bozeman, Mont.

It is very desirable that cement curb and sidewalk work, as well as other concrete work exposed to the weather be covered and kept moist until the cement has had ample time to set and harden. Some good work has been done without taking these precautions, but, especially in hot, dry weather, the drying out of the concrete before the chemical action of setting is completed removes the water necessary for the crystallization, which therefore cannot take place completely. The result is a concrete which has not attained its maximum of hardness and consistency, and, under the hard usage to which a sidewalk and a curb are liable, the wear will be excessive. The surface will evidently dry out the most and the surface is also the part which receives the wear. Covering the walk delays evaporation of the water and also prevents excessive expansion due to heat directly from the sun's rays, with consequent tendency to disintegration of the green concrete. Addition of moisture by sprinkling supplies the loss by evaporation. The length of time that the covering should be left on and that the periodical sprinkling should continue depends upon the quality of the cement and to a slight extent upon the other materials. The condition of the weather is also to be considered, but three days is usually considered sufficient for any conditions of weather or materials. A walk covered with sand kept continually wet will not set as quickly as one covered with an awning and occasionally sprinkled.

There have been some experiments made upon the relative strength of wet and dry concrete. The evidence regarding strength is conflicting, but it is generally conceded that concrete which is mixed with a liberal supply of water, but

not an excessive amount, is more dense than dry concrete. Wet concrete is put into place at a much less cost than dry conrete and is therefore more generally used. This question has been discussed several times within the past three years in the volumes of Municipal Engineering and reference may be made to the following articles for further detail:

"Wet or Dry Concrete," vol. xxv, p. 167; vol. xxiii, p. 92.

"Relative Merits of Wet and Dry Concrete," vol. xxiii, p. 477; vol. xxiv, p. 32.

"Strength of Concrete with Various Aggregates," vol. xxii, p. 12.

"How to Make the Strongest Concrete," vol. xxiv, p. 104.

"Mixing Concrete and Placing It in Position," vol. xviii, p. 30.

"Relative Cost of Concrete Mixtures," vol. xiv, p. 146.

"Proper Consistency of Concrete After Mixing," vol. x, p. 188.

"Proportions of the Constituents of Concrete," vol x, p. 255.

"How Concrete Should Be Mixed," vol. x, p. 264.

The names of manufacturers of molds for testing cement will be found in the "Business Directory," published in each number of Municipal Engineering, under the heading "Cement Testing Machines."

CINDERS FOR BUILDING BLOCKS.

I would like to ask you how locomotive cinders would work with sand and Portland cement in making concrete for building blocks. Would it be necessary to screen the cinders? I would like to find out what the general practice is in using cinders for this purpose.

N. HOTTON, Portland, N. Y.

Cinders are not generally used for making concrete building blocks. Municipal Engineering, vol. xxiv, p. 12, contains an article on "Strength of Concrete with Various Aggregates," in which will be found figures showing that cinder concrete has much less strength under compression than concrete made with any other materials mentioned in the article. This must be taken into account and the blocks cannot be used where the pressure on them will be too great for the resistance of the material.

The use of cinders in making concrete has probably become common because of the desire for a light material for making floors, which would at the same time be strong enough. Blast furnace slag or cinders which have been subjected to heat sufficient to burn out all the coal in the fuel are materials which are fireproof and so make a practically fireproof building material when combined with cement but locomotive and furnace cinders often have much unburned coal mixed with them, and these coal particles are not desirable from any point of view. Cinders free from coal should therefore be used.

Mr. Hagloch in his book, "Art Stone," ($1.50), gives the following as one formula for making artificial stone which he says is now extensively used: "Cement one part, sand two parts, crushed limestone or cinders one-half inch in diameter or less, two parts," The cinders passing through a half-inch screen would be used in this formula and should also be washed clean.

The writer does not recommend cinders for making cement blocks unless with the most careful attention paid to the quality of the material offered and to the use to be made of the blocks. See the answer to a similar question on page 26 of the July number.

ALKALI IN SAND FOR CEMENT MORTAR.

I have been building cement walks at Boulder, Colo., with good success the past two years and came here two months ago, and our walks are not proving satisfactory. We are doing the work the same here as we did there, but the sand and gravel we have used had lots of alkali in it. Would that have anything to do with the walk getting to act rotten and the corners breaking off in such a short time, or in a long time, either?

M. F. C., —— Idaho.

The presence of the alkali is probably the reason for the troubles met with. Can our readers who have had experience with similar materials suggest methods of treatment? The only one occurring to the writer is a thorough washing of the sand and gravel until the alkali is removed.

METAL LETTERS FOR CEMENT WALKS.

Kindly give us the addresses of firms manufacturing and keeping in stock brass or other metal letters for placing in cement walks even with the surface for advertising purposes; letters to be six to twelve inches in size.

F. F. B., LeRoy, Ill.

The following are manufacturers of letters and name plates in the section of our correspondent. There are many others.

W. F. Kienzle, 92 Ohio-st., Chicago, Ill.; Stover Manufacturing Company, Freeport, Ill.; Turner Brass Works, Franklin and Michigan-sts., Chicago, Ill.; Zeigler Bros., Elgin, Ill.; American Brass and

Manufacturing Company, 409 S. Second st., St. Louis, Mo.; Edwardsville Brass Co., Edwardsville, Ill.; Scoville Manufacturning Company, 210 Lake-st., Chicago, Ill.

MAKERS OF SAND-LIME BRICK MACHINERY.

Send address of sand-lime brick machine makers, as we are thinking of making brick.

M. K., St. Johns, Newfoundland.

Reference should be made to the "Business Directory," printed in each number of Municipal Engineering for names of makers of sand-lime brick machinery, under the heading "Sand Brick." The H. Huennekes Company of New York, there mentioned, now has a large number of plants in operation in all parts of the United States.

HAIR CRACKS IN CEMENT STEPS.

Can you enlighten me in any way how to avoid hair cracks in artificial stone steps? Cracks do not show in sidewalks, only in steps. They are made with hollow arched core. Cracks show on rise, not on tread.

E. F. ARN, Kansas City, Kas.

The cause and remedy for hair cracks have been discussed frequently in this department of Municipal Engineering. In this case they may be due to the formation of a thin skin of neat cement along the mold boards, due to the separation of the cement and forcing of it to the surface by tamping, or it may be due to too rapid drying out of the cement, due perhaps partly to the absorption of water from the concrete by the mold boards before they are removed or to the failure to sprinkle the risers as thoroughly as the treads are wet during the curing process. It is probable that all three of these causes operate together. If, as is usual, the risers are finished with a trowel after the molds are removed the first difficulty mentioned may be easily increased. It is always harder to finish a vertical surface so that hair cracks will not appear than to finish a horizontal surface, but it can be done. It is also harder to keep the proper amount of moisture in it. Careful protection from sun and air must be largely depended upon, keeping the surfaces and the air in contact with them as moist as circumstances will permit.

Some cement workers say the hair cracks will form if the outside is kept too wet, as it would be if buried in wet sand, for the inside of the step will then cure first and the difference in condition of inside and outside will cause the appearance complained of.

CONCRETE CULVERTS—HAND RAIL.

I would like to know the most economical specification for concrete drain culverts of 10 to 15 feet span and 18 foot roadway, also what form of retaining wall or wings you recommend and whether hand rail would be advisable in concrete of proper proportions?

J. W. SHACKLETON, Chatham, Ont.

Good specifications for concrete culverts and arches will be found in the "Handbook for Cement Users" ($3) in the chapter on the uses of cement. Descriptions of culverts and arches will also be found in Municipal Engineering. Reference may be made to the following articles: "Dimensions of Concrete Arch," vol. xxiv, p. 436: "A Small Concrete Arch," (illustrated), vol. xxiii, p. 477.

The form of wing wall depends almost entirely upon the local conditions. The most usual form is a wall, at an angle with the face of the arch dependent upon the conditions of the bank, with its top either sloped or stepped down at the proper ratio to act as a retaining wall for the material behind. There are many articles in Municipal Engineering which are illustrated with views of arches and culverts showing the general practice in location and construction of wing walls with some of the modifications made necessary by peculiar conditions in some instances.

A hand rail made all in one piece ought to be satisfactory on a culvert of 10 to 15 feet span, but it should be carefully finished and as carefully sprinkled and protected from sun and air until it has thoroughly cured, to reduce the danger of hair lines on the surface, which injure the appearance though they do not affect the strength. Long hand rails will crack from expansion and contraction if not properly jointed at intervals. It is sometimes thought necessary to cast the hand rail in blocks which are then put together much as stone blocks would be laid.

WATER SUPPLY

Meters—Waterloo Supply—Cost of Pumping—Knoxville Rates Inadequate—Sioux Falls Water-Works Enjoined—Columbia Water-Works Improvements—Bursting Reservoir—Chicago, San Francisco and Oakland Water Companies' Rates Not Lowered.

Meters, Their Use and Benefits.*

By Park Woodward, General Manager Atlanta, Ga., Water Works.

Much could be said in favor of the universal meter system for all water works plants. But having had a practical experience for the past twenty years in the use of meters here, I will confine myself to what they have done for Atlanta.

Prior to 1885 there were no meters in Atlanta. The rate charged for water was regulated by the number of outlets used by consumers.

The consumption of water became so great that it resulted in the necessity of adding to our pumping machinery in order to supply the demand for water and at the same time to give the necessary fire pressure. After a new pump was added and put in operation it was found that the force main leading from the pumping station to the city was too small for the demands made upon it. The loss by friction was enormous, resulting in a great strain upon the pumps and the pipe in the immediate neighborhood of the pumping station, and it was found impossible to give adequate fire pressure.

The only remedy left was to put in an additional and larger main. But the cost of putting in this main was only to be had by extra rate of taxation being levied upon the people. This was extremely unpopular, and the idea was therefore abandoned, and an effort to arrive at some other remedy was considered. In the meanwhile the insurance companies complained of the insufficiency of fire pressure; and then it was determined to try the meter system. It was known that a large per cent of the water pumped was allowed to run to waste; and to effectually stop this waste it would be necessary to make the consumer pay for it. So we adopted then the universal meter system.

Much complaint was made at the time, it being argued that it was unjust to require water consumers to pay for meters to measure the water they paid for. But the Board contended it was the only equitable way, for it was manifestly unfair to take the money from the general tax fund to put meters on consumers in about one-third the territory of the city where water mains were laid, and therefore require those who lived out of the reach of the water supply or fire protection to pay for meters used by those more fortunate in having the comfort and convenience of water supply and fire protection and decreased rate of insurance.

The introduction of meters saved money for the general taxpayers of this city, for without their use the rate of taxation would have been increased in order to raise a sufficient amount of money to pay for an additional main, more pumping machinery and larger reservoir and other necessary additions to the plant, estimated at that time to cost approximately $150,000 or more.

As an illustration of the results of the introduction of the meter system here, the pumpage for the month of November, 1884, when we had no meters, was 132,679,000 gallons, and the coal consumed was 575,000 pounds, being an average pumpage of 4,442,663 gallons per day and the consumption of 19,166 pounds of coal per day.

For the month of November, 1885, with the meters in service, the pumpage was 48,130,000 gallons, showing a decrease in pumpage of 84,549,900 gallons for the month. The coal consumed was 256,000 pounds, showing a reduction in the consumption of coal of 319,000 pounds for the month. The reduction in pumpage was 2,818,330 gallons per day, and in coal of 10,633 pounds per day. If meters had not been introduced our daily pumpage now would be about 25,000,000 gallons per day instead of 8,000,000 as it is, and the outlay necessary to put the plant in condition to meet the demands would have been over a million dollars more than has been spent on it.

*From a paper before the American Water Works Association.

One argument against the use of meters is that it reduces the income. This, of course, depends on what is charged. A minimum rate can be fixed and a maximum amount allowed for that rate. We charge here 80 cents per month for 6,000 gallons or less, and allow a discount of 25 per cent on all bills paid on or before the tenth of the month following the month of consumption. And we charge 10 cents per 1,000 gallons net for all used over 6,000 gallons.

The average domestic consumption here is 3,500 gallons per month. It must be borne in mind, however, that our accounts close each month, so that the minimum rate and maximum allowance commences with the first of each month. The revenue here under the meter system has grown from $32,000 in 1886, to $178,000 in 1903, and it will be over $200,000 in 1904. And in addition to this the city service, that is, fire, sewer, public buildings and grounds, etc., used in 1903, $160,000 worth of water, the same being charged for at the rate it would have been charged had the plant been owned by a private company. Of course no money was paid for this service, but the Water Department took credit for it, as they were entitled to, so as to show the actual earnings of the plant.

Manufacturers are charged a scaling rate of 10 cents per 1,000 gallons net for 75,000 gallons, and scaled each 75,000 gallons ½ cent per 1,000 gallons until it reaches 6 cents per 1,000 gallons. The scaling rate then stops, and all water consumed after 90,000 cubic feet is charged for at the rate of 6 cents per 1,000 gallons net. We have two pumping stations, and the estimated cost to deliver the water, counting operating expenses and interest on the bonded debt, last year was 5.7 cents per 1,000 gallons; so that manufacturers get water practically at cost over and above 90,000 cubic feet.

The appended table will give the result of water consumption, coal consumption and income since the adoption of the universal meter system.

New plant put in operation in 1893.

Old plant abandoned in 1904.

In 1904, meter rate reduced from 17 cents to 10 cents per 1,000 gallons.

EFFECT OF METERS IN ATLANTA, GA.

Year.	Total No. Taps.	No. Taps Metered.	Gals. Water Pumped.	Pounds Coal Burned.	Income.
1883	1,663	95	859,448,080	4,7 1,700	$31,010 20
1884	1,832	570	1,148,420,700	5,624,400	35,763 95
1885	1,973	Genl. Indn.	876,055,000	4,286,000	39,293 33
1886	2,077	1,372	574,925,000	3,008,300	32,745 48
1887	2,192	practically all.	628,478,300	3,569,900	38,066 95
1888	2,464	all	628,931,300	3,402,900	38,286 35
1889	2,883	all	756,762,600	4,070,320	56,369 50
1890	3,273	all	861,241,100	4,683,800	63,438 97
1891	3,759	all	942,960,730	5,097,900	74,431 90
1892	4,533	all	923,451,700	5,506,600	79,695 61
1893	4,934	all	1,206,550,800	8,348,000	81,822 71
1894	5,544	all	no data	5,459,100	65,452 61
1895	5,962	all	1,657,549,110	6,222,700	73,562 83
1896	6,496	all	1,814,963,500	5,647,900	83,339 39
1897	7,176	all	1,895,623,800	6,364,600	92,484 92
1898	7,974	all	1,807,661,800	6,095,100	103,774 54
1899	8,592	all	1,996 908,200	6,698,500	116,302 66
1900	9,277	all	2,146,635,700	6,741,300	133,819 26
1901	9,926	all	2,261,947,100	7,709,400	141,867 09
1902	10,676	all	2,511,687,200	7,884,900	157,041 03
1903	11,654	all	2,484,954,300	8,380,988	177,730 50

The Water Supply of Waterloo, Iowa.

In response to a request from the Mayor of Waterloo, Ia., the United States Geological Survey recently directed Prof. W. H. Norton of Cornell College, Ia., to make an investigation of the geological conditions affecting the water supply of that city. Prof. Norton's report contains some interesting data.

The appeal from the authorities of the city was due to an epidemic of typhoid fever which had raged for several months. The source of the infection had been clearly traced to the city water supply, which is the water of the Cedar River treated by mechanical filtration. This stream had been contaminated by the sewage of Cedar Falls, a town of 6,500 inhabitants, situated five or six miles up the valley from Waterloo. An examina-

tion of the water made by Profs. Albert and Beirring of the University of Iowa, showed that not only the raw water of the river but also the water after treatment at the filtration plant was highly infected with micro-organisms.

Prof. Norton's investigations covered the geological conditions affecting ground and artesian water at this point. Underlying the plain on which Waterloo is situated is a floor of Devonian limestone. The alluvium which has been spread over this valley floor consists of sand and gravel with some finer waste. Because of its loose texture, its ready drainage into Cedar River, and the pervious rock floor on which it rests, this broad terrace seems to contain no large store of ground water.

About five or six miles up the valley strong springs rise from the limestone on both banks of the channel of Cedar river. At the time of Prof. Norton's visit, these were largely concealed from view by high water from the river, but as soon as the stage of water in the river permits, the springs will be carefully measured and their availability considered either as a sole supply or as a partial supply for Waterloo, in connection with artesian wells.

The geologic structure of the region in which Waterloo lies is well known through the work of the Iowa Geological Survey and the surveys of adjoining States, and the probabilities of procuring a supply of artesian water are considered good. To the depth of several thousand feet the underlying rocks consist of alternating beds of limestone, sandstone and shale. These pervious layers are sheathed in several instances with impervious shales, and when tapped by the drill, their waters, which are under hydrostatic pressure, rise toward the level of their sources, which lie in the higher ground of the States bordering Iowa on the north and northeast. The St. Peter sandstone is the first important and reliable water-bearing formation of the series. The Oneota limestone is next in importance. While the drill passes through it, the flow will probably be strongly reinforced from its fissures and sandy seams. The chief water-bearing layer of the series is the Jordan sandstone, the upper member of what has been known as the St. Croix, or the Potsdam. Its normal thickness is about 100 feet.

It is recommended that any artesian wells which may be sunk here be carried to this sandstone. As the amount of water obtainable at Waterloo is of prime importance, Professor Norton advises that experimental boring should extend not only through the 1,400 feet needed to test the capacity of the chief zones of flow, the St. Peter, the Oneota, and the Jordan, but to the depth of 2,500 feet, in order to probe well the Basal sandstone, as the lowest member of the Potsdam formation is called, and to test its water resources also.

The artesian water at Waterloo will be found less pure as to mineral contents than the river water. It is expected that it may contain in solution lime and magnesia carbonates with some lime sulphate, together with the sulphates of magnesia and of soda. It is not probable that these minerals will be present in sufficient quantities to render the water unpalatable or injurious to health, but they will probably be abundant enough to make it an inferior steam water, as several of these minerals form scale in boilers. Possibly the water will carry its own "boiler compound," or minerals which cause injurious substances to be thrown down in boilers mostly as sludge.

The daily water supply required for this city of 16,000 people is estimated by the city officials at 3,000,000 gallons. It is by no means certain that this large amount can be obtained from deep wells. Prof. Norton thinks that more than ten wells will be needed to yield the required amount, and that great caution should be exercised in driving them lest the limit of interference be reached which would make the sinking of other wells unprofitable.

Cost of Pumping Water in Small Plants.

The following comparisons of various methods of pumping water in small water works plants and the cost of the same are taken from a paper on the subject of "Working Costs of Water Works Pumping Engines," presented to the British Association of Water Works Engineers by A. H. Meysey-Thompson and H. Lupton.

I. Surface Pumps: Small Power. Where the water is within suction distance of the pump while the power required is small. Up to 20 horse-power this work is chiefly done by rotative or direct-acting steam pumps. The coal consumption is high, amounting to as much as 10 lb per horse-power in water lifted, while labor costs are also considerable in proportion to the work done. Such circumstances,

however, lend themselves most favorably to the use of electricity (if such be available), either from a central generating station, or, as in the case of large county asylums, from private generating stations in use for other purposes.

As regards the working costs of small installations, the author regrets that, owing to the comparative indifference with which these small plants are regarded, they have no reliable figures, but they consider that a fair estimate for a steam plant of this class, generating, say, 21 horse-power for eight hours a day, or 7 horse-power continuously throughout the year, and employing one man at $8.50 a week, would be: Labor, $63.26 per continuous horse-power for a year, and coal (taking the consumption at 10 lbs. per horse-power hour, equivalent to a duty of rather more than 20,000,000 to cover banking fires and all losses, and supposing the cost to be as low as $2.43 per ton) $95.14 per continuous horse-power per year. Oil and stores would amount to another $14.60 per continuous horse-power per year, and repairs, say, to a further $14.60, making the total cost of one continuous horse-power in water lifted night and day for the year $187.60.

These costs assume the existence of reservoir accommodation sufficient to enable the day's pumping to be done in from eight to nine hours. If pumping were really continuous, the costs would be somewhat higher, as, though some saving would be made in not having to bank fires at night, labor would be higher owing to the necessity of a double shift.

Turning now to the relative cost of pumping by electricity, we notice that the average price of current supplied by the Newcastle Electric Supply Company during the year 1902 (the most recent year for which the figure has appeared) was 2.29 cents per unit, while the total cost to the company was 1.72 cents per unit; it would, therefore, appear that current will shortly be available at 2 cents per unit, and in any case that it can be generated at that figure, and this will, therefore, be adopted as the basis of comparison.

Since no stoker would be needed, we may put the labor at, say, 73 cents per day to cover general supervision, oiling, etc., this item, of course, varying with the position of the station and the amount of other work available. At this rate a plant giving seven continuous horse-power would involve labor charges amounting to $25.31 per continuous horse-power for a year. Instead of fuel there would be electric power, which, at 2 cents per unit and 75 per cent. efficiency, would cost $176.65 per continuous horse-power for a year. Oil, stores, and repairs would, of course, be small with a plant of this kind—say, together, $24.33 per continuous horse-power per year. Thus the total cost of one continuous horse-power in water lifted night and day for the year would amount to $226.29. This, it will be noticed, is higher than that with an independent steam plant; but, on the other hand, the greater convenience of the plant, and the total absence of coal dust, smoke and ashes, may be considered as compensating for this to a great extent.

As an example taken from practice, the actual cost of pumping at an asylum will be interesting. Here the average continuous horse-power in water lifted was only 4.12 (year ended March, 1902). Electricity was supplied at 3 cents per unit, and the water, owing to the necessity of softening, was pumped twice over: first, from a well (lift, 120 ft.), and afterward into a watertower (lift, 96 ft.). Under these somewhat unfavorable conditions, although the cost per 1,000 gallons delivered was not excessive, being 6.86 cents, including repairs, the actual cost per continuous horse-power per year amounted to $550.64.

In many cases, small geared pumps may be, and frequently are, driven by gas engines; it will, therefore, be interesting to consider the relative costs in such cases. Assuming the consumption of gas at 24 cubic feet per horse-power per hour, and the efficiency and other items the same as in the case of electrical plant, it will be found that the price of gas to produce a result equivalent to that obtained with electricity at 2 cents per unit and a similar cost of pumping—viz., $226.29 per continuous horse-power for the year—would be 62.88 cents per 1,000 cubic feet.

II.—Well or Borehole Pumps: Small Power—Where the water is not within suction distance of the pump, it is, of course, necessary to draw from a deep well or borehole, an alteration of conditions which largely modifies the type of plant required.

In a well it is possible to use electricity to operate a three-throw pump. But a plant of this kind involves a considerable cost, not only in making the well, but in supplying the motor, gearing, frame, and three sets of pump rods and "trees." If, however steam is in any way available, it is a much simpler and more efficient plan to use a small beam engine, having the steam-cylinder at one end of the beam and the pump at the other. With a plant of this kind a single pump with a diameter as small as 4 in. and a stroke of 3 ft. can conveniently be

used. Friction is reduced to a minimum, since there is no gearing, and, if desired, the cost of a well can be avoided by fixing the pump in a borehole. By proper utilization of the momentum of the rods the engine can be worked expansively, and as the water pumped can be passed through a brass fitted surface condenser without being in any way contaminated, there is no reason why these engines should not be worked condensing.

A considerable number of such engines are in use, but the authors do not possess any accurate information with regard to annual costs. It is, however, safe to assume that such an engine would be worked, taking the cost of coal as $2.43 per ton, at an average duty of 25,000,000, equivalent to, say 9 lb. of coal per horse-power, (in water lifted) per hour, and on this basis the cost per continuous horse-power per year of a plant of the same size as that taken in case 1—i. e., generating 21 horse-power for eight hours a day, or 7 horse-power continuously—including labor, stores and repairs as before, would work out at $178.11.

Knoxville, Tenn., Water Rates Inadequate.

An opinion by Special Master Henry O. Ewing on the Birdsong water ordinance, which was submitted to him by Judge C. D. Clarke to collect evidence and report in the case of the city of Knoxville vs. the Knoxville Water Co. seeking to enforce the Birdsong water rate ordinance, holds that it is inadequate. He tests the validity of the ordinance regulating water rates, which the city passed March 30, 1901, by the value, as he finds it, of the water company's property March 30, 1901, the estimated income of the water company under said ordinance for its fiscal year ending March 30, 1901, and the actual operating expenses of the company for that fiscal year, and reaches the conclusion that the ordinance is invalid, because it would not allow the water company a fair income on the value of the water plant as it existed March 30, 1901.

He values the entire water plant at $608,427.95; that part of it that pertains to the city, exclusive of the suburbs, at $570,887.95, both valuations being of the date of March 31, 1901; the estimated income from the city part of the plant for the company's fiscal year ending March 31, 1901, at $63,342.40; the actual operating expenses for the same fiscal year at $32,809.98.

The master holds the water company entitled to six per cent. on the value of its property, and to a depreciation allowance of two per cent., and finds that upon the basis of the income, operating expenses and the allowance of 8 per cent., the ordinance of March 30, 1901, would not allow the water company a fair return on the value of its property March 31, 1901, the deficiency of income being some $15,000.

The report will now go to Judge Clarke, who may approve or disapprove it, wholly or in part.

Sioux Falls Must Conform to Law in Building Water Works.

A decision was handed down by Judge Carland, July 11, permanently enjoining the city of Sioux Falls, S. D., from completing the water works plant. The court holds that the city erred, and cites the following points of error:

1. That there is nothing in the terms of the written contract between the city and the water company which would prevent the construction of a system of water works by the city after the period of twenty years specified therein.
2. But, as the construction of such water works by the city would practically destroy the plant of the water company the city in constructing such water works must proceed according to law or else it will be a wrong-doer and must be enjoined.
3. In the year 1903 the city could not incur indebtedness for the construction of water works for the reason that its existing indebtedness nearly equaled the constitutional limit.
4. The vote taken by the electors of Sioux Falls in November, 1901, was annulled by the amendment to the constitution in 1902, and no bonds could be issued thereunder.
5. The electors of Sioux Falls have never had a chance to say by vote whether they would authorize the incurring of indebtedness for the construction of water works, for the reason that at the election in November, 1901, the question was the alternative whether the city should construct or purchase. This was not a submission of either question, as the city could not do both.
6. The city should be enjoined from further construction of water works until it can do so in accordance with law.

Columbia, Mo., May Improve Purchased Water Works.

The Supreme Court of Missouri has rendered a decision in the case of the State ex rel. city of Columbia vs. Albert O. Allen, State Auditor, which involves an application for mandamus to compel the

respondent to register municipal bonds issued by a relator, for the purpose of purchasing and constructing an electric light plant. The decision is as follows:

Cities of less than 30,000 and more than 2,000 inhabitants may, with the assent of two-thirds of the qualified votes, become indebted (under Sec. 12a, Art. 10, Const., adopted in November, 1902) to a larger amount than specified in Sec. 12, Art. 10, not exceeding an additional 5 per cent. of the value of the taxable property therein, for the purpose of purchasing or constructing water works, electric or other light plants, to be owned exclusively by the city.

And this amendment authorizes such cities to become so indebted for the purpose of purchasing water works and for improving the same, and does not restrict such cities to one of two alternatives. When the proposition is plainly put before the voters to buy an old plant and make it available for all purposes, it falls within the meaning and spirit of the amendment of Sec. 12a, Art. 10, of the constitution, and it is not at all necessary to first purchase and then have a second election to improve it, but it can all be submitted at one time, and it is but one proposition.

The Legislature has so construed the amendment by the act of March 23, 1903 (Laws 1903, p. 96) wherein they provide that the City Council of any city "shall have power to erect or acquire by purchase or otherwise, water works, etc." The City Council provided a levy of 35 cents to pay the interest and provide a sinking fund, and it is not a reasonable objection to say that this may not prove sufficient because the assessed valuation may so decrease that the levy would not prove adequate.

No plausible objection can be urged against the Council fixing the rate which reason and experience shows will be ample, when the organic law requires it to make provision for the collection of an annual tax to pay the interest and constitute a sinking fund. Demurrer to petition overruled and peremptory writ of mandamus awarded.

Bursting of a Pennsylvania Reservoir.

The new reservoir of the Citizens' Water Company at Scottdale, Pa., burst July 16 at midnight and more that 300,000,000 gallons of water swept down the valley, taking everything before it and inundating crops and wrecking buildings. About 9 o'clock it was discovered that the dam was in danger of breaking, and messengers were sent through the valley to warn the people of their peril. This was all that saved hundreds of lives, for at 12 the entire valley was under water. The damage to the machinery and reservoir will amount to $50,000.

Chicago Enjoined from Lowering Water Rates.

An injunction was granted by Judge Grosscup July 5 to the Chicago Suburban Water and Light Company, Austin, restraining the city of Chicago from interfering with the present water rate. Trouble has existed ever since the annexation of Austin to the city. The company charged 20 cents per 1,000 gallons of water, while Chicago's rate was 10 cents per 1,000 gallons. The city undertook to force the Austin Company to make the same rate, and passed an ordinance to that effect. Instead of complying, the water company appealed to the United States Circuit Court, alleging that Chicago was infringing on its rights; that an enforcement of the ordinance would mean, practically, the confiscation of the property by the city of Chicago, and would be a violation of the fourteenth amendment to the Constitution of the United States.

In his decision Judge Grosscup held that to compel the Austin Water Company to sell water at 10 cents per 1,000 gallons would, in fact, mean the confiscation of the works, and would be an invasion of rights not compatible with justice or the law. He said:

I very much regret that the Legislature, in authorizing municipalities to fix rates for the supply of water, did not provide for an inquiry or investigation by the city before such rates be put into effect. To attempt to fix rates without inquiry and investigation by the mere passage of an ordinance is, to say the least, crude and unstatesmanlike.

The injunction is a temporary restraining order and the city will endeavor to have it dissolved.

San Francisco and Oakland Enjoined from Lowering Water Rates.

A decision was handed down by Judge Gilbert in the United States Circuit Court of Appeals at San Francisco, Cal., June 29, granting a preliminary injunction in the suit of the Spring Valley Water Company against the city and county of San Francisco. The defendants are restrained from enforcing the ordinance of March 7, reducing water rates. Bond in the sum of $175,000 will be required of the complainant for all damages which the defendants or any person injured by reason of the injunction may sustain if, upon the entry of the final decree, the ordinance shall be sustained. In the case of the Contra Costa Water Company against the city of Oakland, an opinion by Judge Gilbert allows the injunction as prayed for, and the bonds in this case are fixed at $130,000.

CEMENT AND CONCRETE

Concrete Fireproofing—Standard Cement Specifications.

Concrete as a Fire-Proofing Material.

The following is from a report upon the efficiency of fire-proofing materials as shown by their action in the Baltimore fire and will add something to the data given upon this subject in the June number of Municipal Engineering.

The building of the United States Fidelity and Guarantee Company is an interesting example of reinforced concrete in the district. As near as I could ascertain, it was subjected to a severe fire and I found evidence of temperatures up to the softening point of cast iron. The condition of the lower part of the structure and apparently of the whole structure showed the great fire-resisting powers of this type of building. It is of especial interest in that the experiment station made a preliminary test on an arch of this same type and of almost this exact thickness and span and weight of metal, which failed because of the slender 6-in. posts, and not through the failure of the floor, at the end of three hours and forty minutes' exposure to a 1,700 to 2,000 degree F. fire.

Further, in the International Trust Company building, a small paper room having a Hennebique floor and ceiling, was so intensely heated that at the end of three days the lumps of cast iron which had earlier been a copying press and an embossing stamp were still red hot, and yet neither floor nor ceiling show signs of distress. This is the more remarkable in that the walls of the adjoining building fell through the skylight upon the Hennebique floor. There were in the Commercial and Farmers' National Bank and in the National Bank of Commerce concrete floors which stood the fire test well.

The general condition of the fireproof building is such as to indicate to my mind the unfitness of terra cotta for beam and post covering and floor construction as here used when compared with concrete or brickwork. Second, there is no evidence that the tall steel building was subjected to an unusually severe test. While it must be admitted that not enough concrete received the full effect of the fire to make the test a perfectly compete one, when I add to this the experience of several years in examining the action of fire upon concrete, I am convinced that had the floors of the Continental Trust or the Calvert Building been of any one of the better class of concrete types and had the beams and posts been encased in 4-in. coatings of sound concrete their renewal would have required little but plastering.

Little difference in the action of the fire on stone concrete and cinder concrete could be noted, and as I have earlier pointed out, the burning of the bits of coal in poor cinder concrete is often balanced by the splitting of the stones in the stone concrete. I never have been able to see that in the long run either stood fire better or worse than the other However, owing to its density the stone concrete takes longer to heat through, When brick or terra cotta are heated no chemical action occurs, but when concrete is carried up to about 1,000 degrees F its surface becomes decomposed, dehydration occurs and water is driven off. This process takes a relatively great amount of heat. It would take about as much heat to drive the water out of this outer quarter-inch of the concrete partition as it would to raise that quarter-inch to 1,000 degrees F. Now a second action begins. After dehydration the concrete is much improved as a non-conductor, and yet through this layer of non-conducting material must pass all the heat to dehydrate and raise the temperature of the layers below, a process which cannot proceed with great speed.

Much has been said about the uncertainty of concrete. The value of concrete in theory is often admitted by those who consider it unwise to use it because of the difficulty of getting the materials properly proportioned, mixed, and placed in position. I have never been able to see the force of this. It is quite as easy to lay sound concrete as it is to put somewhat irregular and confessedly brittle blocks of terra cotta into place with proper bonding. The main difference seems to be that poor concrete reveals its weakness when it falls

on "pulling the centers," while terra cotta is likely to be strong enough to hold itself in position even when it can do little more. Further, a prolonged search revealed only occasional evidence of temperatures as high as 2,400 degrees F. and no instance could be found of real fusion of terra cotta or brick in them. Occasional evidences of temperature of 2,200 degrees F. were found, but in general there was ample evidence that the temperature of the fire in these buildings had never in most places risen above 1,700 degrees F. This is likely to happen in almost any office building where little care is taken as to the nature of its contents and must be provided for if these buildings are to be proof against the combustion of their own contents.

Proposed Standard Specifications for Cement.

Following are the specifications prepared by the committee on cement of the American Society for Testing Materials, George F. Swain, chairman, which were presented at the last meeting of the society. The report was approved at the convention and will be submitted to letter ballot of the society. Criticisms of the specifications are invited.

General Observations—1. These remarks have been prepared with a view of pointing out the pertinent features of the various requirements and the precautions to be observed in the interpretation of the results of the tests.

2. The committee would suggest that the acceptance or rejection under these specifications be based on tests made by an experienced person having the proper means of making the tests.

3. Specific Gravity.—Specific gravity is useful in detecting adulteration or underburning. The result of tests of specific gravity are not necessarily conclusive as an indication of the quality of a cement, but when in combination with the results of other tests may afford valuable indications.

4. Fineness.—The sieves should be kept thoroughly dry.

5. Time of Setting.—Great care should be exercised to maintain the test pieces under as uniform conditions as possible. A sudden change or wide range of temperature in the room in which the tests are made, a very dry or humid atmosphere, and other irregularities vitally affect the rate of setting.

6. Tensile Strength.—Each consumer must fix the minimum requirements for tensile strength to suit his own conditions. They shall, however, be within the limits stated.

7. Constancy of Volume.—The tests for constancy of volume are divided into two classes, the first normal, the second accelerated. The latter should be regarded as a precautionary test only, and not infallible. So many conditions enter into the making and interpreting of it that it should be used with extreme care.

8. In making the pats the greatest care should be exercised to avoid initial strains due to molding or to too rapid drying out during the first twenty-four hours. The pats should be preserved under the most uniform conditions possible, and rapid changes of temperature should be avoided.

9. The failure to meet the requirements of the accelerated tests need not be sufficient cause for rejection. The cement may, however, be held for twenty-eight days, and a retest made at the end of that period. Failure to meet the requirements at this time should be considered sufficient cause for rejection, although in the present state of our knowledge it cannot be said that such failure necessarily indicates unsoundness, nor can the cement be considered entirely satisfactory simply because it passes the tests.

Standard Specifications for Cement.

1. General Conditions.—All cement shall be inspected.

2. Cement may be inspected either at the place of manufacture or on the work.

3. In order to allow ample time for inspecting and testing, the cement should be stored in a suitable weather-tight building having the floor properly blocked or raised from the ground.

4. The cement shall be stored in such a manner as to permit easy access for proper inspection and identification of each shipment.

5. Every facility shall be provided by the contractor and a period of at least twelve days allowed for the inspection and necessary tests.

6. Cement shall be delivered in suitable packages with the brand and name of manufacturer plainly marked thereon.

7. A bag of cement shall contain ninety-four pounds of cement net. Each barrel of Portland cement shall contain four bags and each barrel of natural cement shall contain three bags of the above net weight.

8. Cement failing to meet the seven-day requirements may be held awaiting the results of the twenty-eight-day tests before rejection.

9. All tests shall be made in accordance with the methods proposed by the Committee on Uniform Tests of Cement of the American Society of Civil Engineers, presented to the society Jan. 21, 1903, and amended Jan. 20, 1904, with all subsequent amendments thereto.

10. The acceptance or rejection shall be based on the following requirements:

Natural Cement.

11. Definition—This term shall be applied to the finely pulverized product resulting from the calcination of an argillaceous limestone at a temperature only sufficient to drive off the carbonic acid gas.

12. Specific Gravity—The specific gravity of the cement thoroughly dried at 100 degrees C., shall be not less than 2.8.

13. Fineness—It shall leave by weight a residue of not more than 10 per cent. on the No. 100, and 30 per cent. on the No. 200 sieve.

14. Time of Setting.—It shall develop initial set in not less than ten minutes, and hard set in not less than thirty minutes, nor more than three hours.

15. Tensile Strength.—The minimum requirements for tensile strength for briquettes one inch square in cross-section shall be within the following limits, and shall show no retrogression in strength within the periods specified:

Neat cement:

Age.	Strength.
24 hours in moist air.....	50—100 lbs.
7 days (1 day in air, 6 days in water)	100—200 lbs.
28 days (1 day in air, 27 days in water)	200—300 lbs.
One part Cement, Three Parts Standard Sand:	
7 days (1 day in air, 6 days in water)	25— 75 lbs.
28 days (1 day in air, 27 days in water)	75—150 lbs.

16. Constancy of Volume.—Pats of neat cement about three inches in diameter, one-half inch thick at center, tapering to a thin edge, shall be kept in moist air for a period of twenty-four hours.

(a) A pat is then kept in air at normal temperature.

(b) Another is kept in water maintained as near 70 degrees F. as practicable.

17. These pats are observed at intervals for at least twenty-eight days, and, to satisfactorily pass the tests, should remain firm and hard and show no signs of distortion, checking, cracking or disintegrating.

Portland Cement.

18. Definition.—This term is applied to the finely pulverized product resulting from the calcination to incipient fusion of an intimate mixture of properly proportioned argillaceous materials, and to which no addition greater than 3 per cent has been made susequent to calcination.

19. Specific Gravity.—The specific gravity of the cement, thoroughly dried at 100 degrees C., shall be not less than 3.10.

20. Fineness.—It shall leave by weight a residue of not more than 8 per cent on the No. 100, and not more than 25 per cent on the No. 200 sieve.

21. Time of Setting.—It shall develop initial set in not less than thirty minutes, but must develop hard set in not less than one hour, nor more than ten hours.

22. Tensile Strength.—The minimum requirements for tensile strength for briquettes one inch square in section shall be within the following limits, and shall show no retrogression in strength within the periods specified:

Neat Cement:

Age.	Strength.
24 hours in moist air .....150—200 lbs.	
7 days (1 day in air, 6 days in water) ....450—550 "	
28 days (1 day in air, 27 days in water) ....550—650 "	
One part Cement, Three Parts Sand:	
7 days (1 day in moist air, 6 days in water) .....150—200 "	
28 days (1 day in moist air, 27 days in water) .....200—300 "	

23. Constancy of Volume.—Pats of neat cement about three inches in diameter, one-half inch thick at the center, and tapering to a thin edge, shall be kept in moist air for a period of twenty-four hours.

(a) A pat is then kept in air at normal temperature and observed at intervals for at least twenty-eight days.

(b) Another pat is kept in water maintained as near 70 degrees F as practicable, and observed at intervals for at least twenty-eight days.

(c) A third pat is exposed in any convenient way in an atmosphere of steam, above boiling water, in a loosely closed vessel for five hours.

24. These pats, to satisfactorily pass the requirements, shall remain hard and firm and show no signs of distortion, checking, cracking or disintegration.

25. Sulphuric Acid and Magnesia.—The cement shall not contain more than 1.75 per cent of anhydrous sulphuric acid nor more than 4 per cent of magnesia.

STREETS AND LIGHT

Paving Guaranty—Rock Island Ordinance—Assessment Upheld—Detroit Asphalt Plant—Bitulithic in Cincinnati—Richmond Electric Light Plant—Bay City Lighting Plant Enjoined—Bituminized Fiber Conduits.

Stockholders Ask Injunction Against Contract for Guaranty of Pavement by Brick Company.

A bill of exceptions was filed to the decision of Judge Henry C. Hammond of the Superior Court of Richmond County, Ga., July 13, by William H. Fleming, in the case known as the "paving case." Judge Hammond dissolved the injunction proceeding against the Georgia Vitrified Brick & Clay Company, to whom the contract for paving Broadway-st., in Augusta, was awarded. The injunction suit was brought by one of the holders of common stock in the contracting company, on the ground that under the charter of the company they had no right to contract for laying the pavement and giving bond guaranteeing the work for ten years, and alleging that such a contract is hazardous and likely to involve the company, entailing great loss to the shareholders. A petition for a stay and supersedeas was refused. This gave the company time to sign the contracts with the city and begin the work. The bill filed July 13 is what is termed a "fast bill of exceptions," and will go up as quickly as the clerk can prepare the necessary papers. The bill is an injunction in which delay renders null and void the intent of the proceedings. The case is carried up on the ground that in their charter the company has no authority, power or right to enter into a contract such as has been made with the city. The right of the company to sell the brick and guarantee the same is not questioned, but the right to enter into the contract for paving with any guarantee to pave and maintain the street for any given time is denied. Should the bill of exceptions be sustained and the lower court reversed, the court again intervenes, and the contract cannot be completed as it now stands. In this case the only relief would be for the company to enter into a new contract with the city, taking the contract for the brick only, and allowing the contractors for laying the brick to give bond for the other work. The work of paving will continue while the case is pending.

Validity of Rock Island Paving Ordinance Affirmed.

In a decision rendered by Judge Parmenter in the county court July 9 the validity of the ordinance for paving Fourteenth-ave., from Elm to Moline-sts., at Rock Island, Ill., was sustained, and every objection which had been filed by the protesting property-owners was overruled. The claim was made that the ordinance was passed without a petition from the property-owners. The court held that under the new State law the Board of Public Improvements could originate an improvement without a petition of the property-owners. To the claim that the city could only assess the abutting property-owners for the proposed improvement, the court held that the city may set off a district abutting on the thoroughfare and assess all property within the district for the construction of the improvement. The property-owners also contended that the city had not established a grade on the thoroughfare previous to the passage of the ordinance, but the court held that the city has properly conformed with this section of the statute. The question of benefits in the case will be passed on by a jury, but no time for a hearing has yet been fixed.

Assessment Attacked on Trivial Grounds Is Upheld.

The Supreme Court of Washington rendered a decision July 14 against Lucien H. Alexander in his attempt to secure an order from the courts directing the city of Tacoma to reopen the assessment proceedings affecting the property assessed for the paving of Tacoma-ave., between N. Fourth and N. Fifth-sts. The improvement was made in 1892 and the prop-

erty benefited was assessed $5,800, while the work cost but $5,795. The first assessment was declared invalid by the courts and the city subsequently adopted three ordinances reassessing the property. Protests were heard under one of these ordinances, but were continued and the plaintiff was orally informed that he would be notified of further proceedings. A new ordinance was passed by the Council, repealing the other and reassessing the property after giving only the statutory notice. The time for appeal passed and the reassessment was confirmed. The plaintiff based his case on the ground that the reassessments were made without just regard to benefits, for more than the actual cost of the work, and because reassessments were made for future repairs, and because he had received insufficient notice under the peculiar circumstances of the case. The Supreme Court halds that wnile the exceptions to irregularities complained of might be well take if the proceedings were up for review, they are not sufficient to render the assessment void. The judgment of the lower court is, therefore, affirmed.

Progress of the Detroit Asphalt Plant.

The Detroit daily press reports that the municipal asphalt paving plant saved the city over $2,500 during its first three weeks of operation, having laid 9,548 square yards of patching for $8,240.31 or 86 cents a square yard as compared with the contract price last year of $1.12.

A critic of these figures proposes to add 10 per cent. for a 10-year guaranty, 15 cents a yard for wear and tear on the plant, and the salaries of the chief inspector and his assistant for a year, forgetting that patching under contract was not guaranteed for any length of time and that it is hardly fair to charge the salaries of two men for a year to their work for three weeks. The chief inspector states that the assistant's salary was charged in the labor pay roll at its actual cost for the three weeks, $63, and that his own salary was not charged against the plant in making the comparison with last year's price because the city paid him last year for inspection the same amount that it paid him this year for operating the plant, so that if it should be added to this year's 86 cent rate, it should also be added to last year's $1.12 rate. It is probable also that the charge of 15 cents a yard for wear and tear of the machinery is too great. It certainly is for three weeks of the first operation of the plant, but can be estimated more closely at the end of the year.

A detailed report of operations from June 8 to July 13 both inclusive shows as follows:

115.8 tons asphalt at $25.50	$2,952 90
52.17 tons asphaltic oil at $25.90	1,351 60
671.76 cubic yards sand at .56	376 13
293.90 tons binder stone, at .90	264 51
84.96 tons limestone dust at $3.50	297 30
83 tons of coal at $2.65	219 90
28 cords wood at $3.65	102 20
Lubricating oil	18 00
Cement	13 30
Total	$5,596 00
Cost of labor at plant, including office and teaming from plant	$ 2,129 50
Cost of labor on street, including foreman and hauling off old material	3,135 90
Cost of unloading material at plant, cleaning up about plant, interest on plant and $100 allowed for repair	378 32
	$11,248 89
Cr.—	
Receipts for screenings, old oil barrels, and work for street railway company	150 00
Net cost	$11,098 89
Yardage—	
Woodward avenue	3,837.10 yds.
Lafayette avenue	7,642.38 yds.
Fort street	1,296.81 yds.
Total	12,776.29 yds.
Average cost per yard	86 8-10 cts
Cost of material, per yard	43 8-10 cts.
Cost of labor, per yard	43 cts
Cost of 12,776.29 yds. at $1.12	$14,309 44
Actual cost	11,098 89
Saving	$3,210 55

Warren's Bitulithic Pavement in Cincinnati.

In an opinion by City Solicitor Hunt of Cincinnati, O., July 11, he held that Warren's bitulithic pavement can be legally laid in that city under the general provisions laid down by Mr. Fred J. Warren, president of Warren Brothers' Company. Under the Ohio law and a decision of the Supreme Court, a patented article may be used for street paving under specifications which will admit of competition. One provision in such specifications would be that the patented article would be furnished to any contractor at a stated price. This would mean, in the case of bitulithic paving, that certain

bituminous cement or other material, with the advice and superintendence furnished by the Warren Brothers' Company, would be sold to any successful bidder at fixed prices. Competition would result between contractors in furnishing other materials required, in doing grading or in other extra work and in the matter of labor.

The Municipal Electric Lighting Plant at Richmond, Ind.

The report of the electric light commissioners of the city of Richmond, Ind., for the year ending May 31, 1904, the first full year since the plant was put in operation, has been received. The plant has been laboring under some disadvantages which are noted in the description of the plant given in Municipal Engineering, vol. xxiv, p. 122. The contract with the electric lighting company for street lighting does not expire until Sept. 1, 1904, but the plant has been operating 87 street lights and lights for parks, and both construction expense and cost of operating have been proportionately large on account of the necessary scattering of the lamps. The rates for commercial light and power are very low, even for a municipal plant, and it is possible for a consumer of 1,000 kw. a month, by taking advantage of the discounts for prompt payment, to procure the service for 4.8 cents a kilowatt, and the ordinary consumer pays from 6.4 to 7.2 cents a kilowatt. These rates are exceedingly low.

The report shows total receipts from light and power of $32,557.42 and total operating expenses, $25,655.66, and an excess of receipts over operating expenses of $6,901.76. The receipts include $7,580 from the city for operating the street and park lights named.

To show the actual conditions the excess of receipts must be offset by interest and depreciation on the cost, say 10 per cent. of the cost, $18,648, and the salaries of the commission $850, making a considerable deficit which the city must ultimately pay.

New construction during the year cost $15,246.39, on which the city paid $7,500, in addition to its payment of interest on the bonded indebtedness, which is not included in the commission's report, but amounted to $5,760.

Undoubtedly the operation of the plant will make a more favorable showing when gets into full operation, but the excessively low rates and the competition of a company with unlimited capital which is trying to hold the field will cause the operations to show a deficit until some changes in the conditions are made. The city pays $90 a lamp for the lamps furnished by contract with the lighting company, and the municipal plant is paid $75 per lamp for those supplied by it.

Bay City, Mich., Enjoined from Completing Lighting Plant.

Suit was begun July 6 at Bay City, Mich., to enjoin that city from establishing an electric light plant. The Bay City Traction and Electric Company instituted suit in its own behalf to restrain the city from issuing $50,000 electric light bonds awarded several weeks ago to W. J. Hays & Sons of Cleveland, and a temporary injunction was issued July 7, as asked for in the bill, restraining Mayor Woodworth and Comptroller Moore from signing the bonds and otherwise completing their issue.

Bituminized Fiber for Conduits.

An article in Municipal Engineering, vol. xxvi, p. 311, gave quite a full statement of the necessities for conduits in many cities for placing electric light wires under ground and of the great desirability in all populous places of removing overhead wires, so that it is not necessary to repeat these points at this time. The slow progress made for many years in burying wires was due to the great expense, but not less to the lack of efficient conduit systems. A sketch of the application of a material long used for other purposes to the successful solution of the problem of efficiency will be of interest.

The telephone companies were the earliest to demonstrate the practicability of the conduit, their first service having been the old "pump logs" such as Aaron Burr and his Manhattan Company used to conduct water to the city. These companies have also advanced faster than the other lines in this direction. They soon discovered that, while the cost of installation was expensive, other things made the conduit cheaper in the end than the overhead system. Two storms alone, in 1900 and 1903, demonstrated the losses that could be inflicted upon overhead systems. It is estimated that from the latter the damage to but four cities

amounted to some $50,000, or, in other words, the loss of interest at 5 per cent on a million-dollar investment.

The old pump log was not long in use, as it fell short of electrical requirements in every respect. The iron pipe was next tried, but this proved too costly—it cost several times as much as the old pump log. So, later, the electrical companies experimented with drain pipe, or sewer tiles, which was the beginning of the clay conduits still in use. Along with the introduction of the latter several other kinds were tried, with more or less success, most of them falling into disuse, one after the other.

The aim of engineers has been to secure a conduit that would be an insulator, that would protect the cable mechanically and electrically, and that would be light, strong and durable, and would permit the easy passage of the cable through it, and would be so smooth as not to abrade the latter. It was eventually discovered that the electrolysis proof bituminized fiber conduit, which the American Conduit Company had been using in California and the Southwest, for irrigation, was almost ideal for electrical purposes. This is made of especially prepared paper, saturated under pressure with a bituminous composition, and built up—also under pressure—of a number of laminations. This gives a perfectly smooth interior and exterior surface. The American's conduit is made in standard lengths of seven feet and in sizes ranging from one to ten inches in diameter.

The cost of the conduit pipes thus formed is not greatly different from pipes made of such materials as clay, but the lightness of the bituminized fiber, the small number of joints and especially the low cost of the unskilled labor which can be largely used in laying it, give it an appreciable advantage in cost over other forms of conduit when laid in the trench.

To recur to its transformation from an irrigation pipe to an electrical conduit, it was found, in the first service, that there was absolutely no leakage, and that its endurance was wonderful. Filled with water for days, it would be perhaps as many days without a drop in it, and would yet remain water-tight and would be in no way impaired. So it was thought that if it would hold water it would keep it out—and the latter has always been the particular requirement for electric work. In all electrolysis tests it has come forth unscathed under the same conditions that have effectually destroyed other conduits. Its ability to withstand exceptionally high voltages has been fully demonstrated, even 50,000 volts not being sufficient to break it down.

It is somewhat surprising that all the towns of the country have not seen the advantages of installing their own conduit systems; for these advantages are so many, so varied, and so valuable. Passing over the setting of fires by overhead wires, there is the greater danger of their spread, since the telegraph poles, with their myriad wires too often frustrate the efforts of the firemen to prevent the latter.

Then there is the matter of the superior appearance of the town, whose architectural and other excellencies are not marred by the unsightly telegraph or other poles, and the security that is found when the severest storms pass harmless, and without a moment's interruption of business intercourse. There can be no "mixup" caused by fallen wires, and therefore no confusion or interruption, for in the subways each cable has its separate duct. And it is for these reasons that all conventions of experts have, of late years, recommended putting all wires in underground conduits.

SEWERAGE

Contractor's Abandonment of Contract—Chicago Must Let Sewers by Contract—Plainfield Septic Tanks—Chicago Public Works.

Winona, Minn., Recovers Extra Cost From Contractor Who Abandoned Work.

The Supreme Court of Minnesota handed down a decision July 1 in the case of the city of Winona vs. Jackson & Bokorny and the Fidelity and Deposit Company. Jackson & Bokorny had the contract for constructing sewer mains, and when they came to laying the deep mains under the water line, they stopped work. The city then finished the contract. The city owed Jackson & Bokorny, when they quit work, $3,176.83 for work performed, and had they completed the work, would have owed them $6,539.64. Both of these sums were held back by the city and a decision rendered by Judge Snow in January, 1904, awarded the city the actual cost of completing the work of the contract above the money held back. This, with the costs and interest, made the amount held to be due the city, $13,839.28. The city made a claim for $8,000 liquidated damages, it being stipulated in the contract that damages of $25 a day should be paid by the company for every day after a specified time that the contract was not completed.

The city appealed to the Supreme Court from Judge Snow's decision, and at the same time the defendants appealed from the verdict given to the city of Winona. The Supreme Court sustains the decision of Judge Snow. The original sum sought by the city, exclusive of the liquidation damages, was $11,774.96. The amount that it will receive, however, will be considerable larger than if a settlement had been effected at the time of the first decision, as the interest and costs now brings the amount up to about $18,000.

Chicago Must Construct Sewers by Contract.

The Illinois Supreme Court handed down a decision June 24 holding that city work on the intercepting sewers in Chicago, particularly the Lawrence-ave. sewer, should be done under the contract system and that the Mayor and his subordinates erred in taking the contract for the work from Joseph Hanreddy, the contractor who put in the lowest bid for the work.

Plainfield, N. J., Settles Infringement Suits on Septic Tanks.

We are advised by the Cameron Septic Tank Company of Chicago, Ill., that after a careful investigation by expert patent attorneys the city authorities of Plainfield, N. J., have opened negotiations for an amicable settlement of the suit commenced against the city for infringement of United States patents owned by the company. The city of Plainfield has installed septic tanks regardless of these patents. The settlement was effected on the payment of $4,000 for a license and the admission on the part of the city of the validity of the patents.

Chicago Public Works.

By Charles B. Maugham, Chicago, Ill.

An abnormal mid-summer dullness pervades nearly all lines of construction and engineering business. There is little new business and some contracts already made have been cancelled or are being materially curtailed. The market for cement is very quiet and prices are ranging lower. The eastern product is bringing from $1.30 to $1.35 while some of the western mills have taken contracts as low as $1.20. Many mills closed and others are running short time. Ample stocks are on hand. Dealers are buying only what is actually needed for immediate requirements.

The Drainage Canal trustees have let contracts for a new bascule bridge at Twenty-second-st. to cost $100,000. The engineering committee of the Board of Trustees has adopted the recommendations of Engineer Isham Randolph relating to the proposed canal, which will turn the sewage of Evanston, the northern suburb, from the lake into the main drainage canal. The cost is estimated at from $2,500,000 to $3,000,000. The canal will be 8.31 miles in length, with a bottom

width of 40 ft. and a depth of 12 ft. The residents of Evanston propose to convert the canal into a work of art by constructing a boulevard and parkway on either bank and erecting frequent ornamental iron bridges.

The Board of Local Improvements has just let contracts aggregating nearly $500,000 for paving in various parts of the city, to be finished this fall.

The City Council has indorsed the plan of the Board of Local Improvements providing for the construction of the new extensive sewer system on the south side with cement instead of brick. The cost of the new sewer will be $745,000 and it will be completed within two years. It will be the first big system of sewers in Chicago to be built of concrete, and the saving over brick is estimated at $80,000.

Fourteen of the small parks of Chicago are to have neighborhood center buildings, constructed by board of commissioners of the South Side for the free use of societies and other public organizations, under such restrictions as the commissioners will impose.

MUNICIPAL AND TECHNICAL LITERATURE

New Publications—Municipal and State Reports.

New Publications.

A Treatise on the Manufacture of Artificial Stone and Concrete for Building and Ornamental Purposes. By Fred W. Hagloch. C. E. 126 pp. Cloth, $1.50. Art-Stone Publishing Company, Cleveland, O.

The author of this book has had much practical experience in the handling of concrete and in the making of artificial stone. That he has not had equal experience in making books should not cause the reader of his volume to form a low opinion of its value. It is true that the author's information is not exact upon subjects with which he is not practically acquainted and that his theoretical knowledge of the material with which he works is not complete nor always accurate, but if the reader will separate the book into two parts, practical manipulation and other knowledge and theory, he will find that the author is informed upon the former and can be safely followed, but that his field of view is too restricted and his volume of information too small to make him a safe guide outside of this field. The latter is exemplified by his misuse of many words in the text, not to mention their bad combination into sentences, and by numerous definitions in his glossary. Thus, he defines abutment as that part of a pier from which the arch springs, bevel as an instrument for taking angles, Portland cement as a cement made of stone, marl, shale or clay or parts of each, and gives many similar partial or one-sided definitions which are often on this account misleading or almost wholly incorrect.

The excellencies of the book for practical men outbalance these defects if their existence is borne in mind, and this is the first book which gives any connected view of the practical side of concrete block construction.

Chapter two on the materials used is excellent, although the author, like many intensely practical cement workers, is wedded to rough and ready cement tests to the exclusion of the more detailed and accurate methods of engineers and chemists. It can be followed safely with due allowance for this exception, and, in addition to the ordinary materials, it gives instructions about proportions of materials for artificial stone, details of coloring matters and proportions required for various effects, fireproofing, filtering stones, plastering, etc. The chapters on mixing concrete and on seasoning blocks also contain many practical points not very well arranged.

Short chapters give some details of special constructions in buildings, a brief description of concrete-steel arches from Municipal Engineering, with the addition

of Mr. Hagioch's own arch, and apparatus for making monolithic walls and buildings. Descriptions of several of the prominent machines and processes for making concrete blocks are included, also a chapter on patents upon the same, both being far from complete.

The catechism in chapter eight is perhaps the most valuable part of the book to the practical man as it answers the commonest questions directly and to the point. It is recommended to many of our correspondents who have sent similar inquiries to our question department and it has in a few pages the answers to most of these questions which have been answered in that department during the past four or five years with some others equally valuable.

The Michigan Technic. 1904. Published by the Engineering Society of the University of Michigan. Ann Arbor Mich. Paper. 114 pp. 50 cents.

A memorial of Professor Greene and biographies of Professors Cooley and Davis open this number of the Engineering Annual of the University of Michigan. Electricity, drafting-room practice, good roads, cement manufacture, locomotive tests, gas engines, surveying, lubricating oils, are some of the subjects treated by graduates and undergraduates in very thorough manner. The volume is well worth its cost.

Municipal and State Reports.

Tenth Annual Report of the Commissioner of Public Roads of New Jersey, for 1903. Henry I. Budd, Commissioner, Trenton, N. J.

During 1903 the appropriation of $250,000 made by the State for good roads was expended on 155.29 miles of new construction in 17 counties. This is the same length of road as in 1902. The total cost of the roads is three times the State's appropriation. Since the passage of the State aid law the State has aided in the construction of 952 miles of road and expended $1,515,168. There are now 476 miles of road petitioned for at a total estimated cost of $2,195,247, which would require the State's usual appropriation for three years. The most populous sections of the State are now quite well covered with good roads and they are being extended into the less developed regions as their benefits are demonstrated.

The report contains a number of excellent essays upon construction and repair of macadam and gravel roads, the qualities of gravel, drainage, State aid laws and the influence of good roads.

Annual Report of the City Engineer of Newton, Mass., for 1903. Irving T. Farnham, City Engineer.

Of particular interest are the following items taken from this report:

The Grade Crossing Commission has made a report recommending the abolition of grade crossings through Newton Center and Newton Highlands by lowering the grade of the railroad and slightly raising the streets at the crossings.

The telegraph and telephone company puts in each year at least five miles of underground conduits and now has over 17 miles. The lighting company has recently agreed to expend $5,000 each year in the construction of conduits.

A small district in Newton Upper Falls required sewerage, for which a gravity outlet would have cost $45,000. Until the district develops this cost was excessive. In the meantime a pumping station consisting of two six-horse-power gasoline engines and two 3½-inch centrifugal pumps has been installed to force the sewage through 1,400 feet of 6-inch pipe into an existing sewer. Either engine can drive either pump and the collecting well is divided so that the whole pumping station is in duplicate. The capacity of the pumps is 300 gallons a minute for each. The station is entirely of concrete. The whole plant cost $6,700, and the cost of fuel used in pumping sewage has been $0.012 per 1,000 gallons pumped. If the outlet sewer should be constructed in ten years and the pumping station thrown away the estimated saving over the interest on the larger cost is $500 a year, and it is probable that this larger construction can now be delayed still longer.

The sewer discharge is estimated from automatic gauges and for the entire system averages 2,825,280 gallons a day or 109.3 gallons per capita. The maximum is double this average. The gaugings also indicate an inflow of 2,300,400 gallons of ground water a day, or 14,532 gallons per mile of sewers and connections.

Annual Report of the Board of Street and Water Commissioners, Newark, N. J., for year ending Dec. 31, 1903. Joseph S. Vinson, Pres., M. R. Sherrerd, Engineer and Supt. Dept. of Water.

This volume opens with Mr. Sherrerd's report, and the first diagram shows the effect of the setting of meters on wasteful consumers. At the end of 1898 there were about 3,300 meters in use or 10 per cent of the number of taps. The consumption was over 840 gallons per tap. All meters had been set by consumers prior to this date. During 1899 and 1900,

the city set 4,116 meters on wasteful consumers selected by inspection. The total number of meters in use at the end of 1900 was about 10,400 or nearly 30 per cent of the number of taps. The consumption had been reduced to 700 gallons per tap. At the end of 1903 the daily average consumption has increased to about 718 gallons, the percentage of taps metered has increased to over 40 although the consumers have set their own meters during the past three years. They have been induced to do so by the absence of a minimum rate with meter on the tap. The total daily average consumption has apparently increased at the same rate as the number of consumers. The necessity for the development of a new water supply has been postponed at least five years by the stopping of the waste of the 4,116 detected careless users. The proportion of income received for metered water has increased from 55 in 1902 to 58 although the proportion of taps metered is less than 40 per cent of the whole. The maximum daily average consumption was nearly 33 million gallons in February, 1899. The maximum since that time was less than 29 million gallons in Februarv. 1902.

The reports of the street and sewer departments show the usual amount of new and repair work done. The latter has the following tables of cost of pipe sewers, basins and manholes.

AVERAGE COST OF PIPE SEWERS, BASINS AND MANHOLES.

	1897	1898	1899	1900	1901	1902	1903
Eight (8) inch	$0.34	$0.28	$0.48	$0.37	$0.49	.....	$0.89
Ten (10) inch	0.44	0.55	0.57	0.59	0.65	$0.62	0.97
Twelve (12) inch	0.48	0.55	0.52	0.72	0.86	0.70	1.00
Fifteen (15) inch	0.65	0.79	1.03	0.90	1.01	0.98	1.47
Eighteen (18) inch	0.79	1.05	0.99	1.05	1.34	1.25	1.77
Twenty (20) inch	1.05	1.05	1.40	1.65	1.85	1.85	1.75
Twenty-two (22) inch	1.27	1.27	1.80	1.80	2.30	.....	.....
Twenty-four (24) inch	1.54	2.02	2.09	2.25	2.25	2.35	3.30
Average	0.82	0.94	1.11	1.17	1.34	1.29	1.59
Basins	87.00	83.00	92.00	87.00	101.00	98.00	122.00
Manholes	27.00	29.00	34.00	31.00	37.00	34.00	39.00

MAXIMUM, MINIMUM AND AVERAGE COST OF PIPE SEWERS, 1903

Size.	Maximum.	Minimum.	Average
8	$1.00	$0.72	$0.89
10	1.20	0.78	0.97
*12	1.40	0.75	1.00
15	1.95	1.25	1.47
18	1.97	1.50	1.77
20	2.05	1.45	1.75
24	3.30	3.30	3.30

*Twelve (12) inch pipe on Lyons-ave. costing $7.00 per foot on account of excessive cut not included in above tables.

New York State Museum. Twenty-second Report of the State Geologist, 1902. Frederick J. H. Merrill, Dir. Paper 140 pp. 40c.

The parts of this volume of interest to our readers are the reports on the economic geology of western New York and Monroe, Tompkins, Onondaga, Oneida, St. Lawrence and Essex Counties, giving some account of the business in building materials in these counties in 1902, including cement, lime, gypsum, brick, sewer pipe, building stone, etc.

Annual Report of the Water Department of Woburn, Mass., 1903. R. E. Walsh, Water Registrar.

Receipts, practically all from water rates, were $47,616 in 1903 and do not include any allowance from the city for hydrant rentals. Maintenance cost $13,995, leaving $2,660 to pay for interest, $27,500 for maturing bonds and $2,430 to sinking fund. Apparently the water consumers are paying more for water than they should, relieving the non-using taxpayer of his share of the cost of fire protection and public uses. The waste of water is increasing and the limit of the supply is very nearly reached. Unless something is done to check waste it will be necessary to make large expenditures for a new supply by the time the small remaining indebtedness is paid.

Lightning struck one pipe on account of its use as a ground for a telephone wire, causing twenty-seven breaks and the resulting damage is now a subject of controversy with the telephone company.

The water furnishes one of the few examples in this country of action upon lead pipes sufficient to arouse suspicion of the safety of the use of lead or lead-lined pipes.

An argument for meters to reduce waste and postpone the threatened necessity for a new supply and new pumps is made and at the same time an appropriation for plans for a new supply is recommended.

ORGANIZATIONS AND INDIVIDUALS

Samuel M. Jones—Technical Meetings—Personal Notes.

Mayor Samuel M. Jones.

By J. A. Stewart, Philadelphia, Pa.

The death of that virile and pronounced promoter of municipal ownership and of Christian sociology, the late Samuel M. Jones, Mayor of Toledo, naturally brings into prominence the public life and record of the owner of the sobriquet "Golden Rule" and municipal executive. It is apropos, too, to note the character and work of the man who furnishes a unique and uncommonly interesting study.

Reviewing Mr. Jones's seven years of public service, from the standpoint of what he has actually done, it is not to be gainsaid that he has not only set an impressive and suggestive example to business men and to manufacturers in the treatment of his employes; to Christians by embodying the Golden Rule in private and in public life, and to politicians by his fearless, unswerving integrity and by his holding office as a trust; but also to civic heads by the introduction of honest, considerate and practical methods in administration. Canes instead of clubs in the policemen's hands; the merit system, and the eight-hour day in the police and waterworks departments were the beginning of his program as Mayor of Toledo in 1897, which further proposed such ideals as a single chamber of Council, city bids, a uniform wage system, a municipal lighting plant, the abolishment of the contract system, city control of all enterprises which relate to public convenience and comfort, the establishment of a purchasing agency to stop the waste of department supplies, park and street improvement, the adoption of the referendum, etc., some of which were realized. His radical views, however, seem to have been too far in advance of the community in which he was set. His impatience with what he conceived to be social wrongs was probably not sufficiently tempered. His outspoken ways, amounting to brusqueness, undoubtedly caused him to be misunderstood. Many people naturally could not comprehend his point of view. His sphere of political usefulness was consequently not enlarged beyond the immediate boundaries of his own city, whose working people, regarding him with evident good reason as their best friend, have kept him continually in the mayor's chair. The influence of his social teachings and practice, however, has had no limit, but has radiated far and wide.

The growth of socialism among us makes of wide interest the attitude of such virile men as Mayor Jones towards existing social conditions.

Mayor Jones stood against what he called "a dishonest social system" whose fruits are the private fortune on the one hand and an army of tramps and millions of paupers and criminals on the other. Competition is to be abolished for that form of co-operation which is termed "the offspring of justice and progress."

In industrial matters Mayor Jones called for "a fair play, Golden Rule system."

"The most important factor in the industrial and social situation is not a machine nor even a sum of money, 'but a man,' he was fond of saying. 'Whatever is against manhood is against the industrial prosperity of a nation and men should be guarded from it. For men should have some leisure. They cannot have moral or mental manhood without it.'"

Mayor Jones's errors, and according to his opponents they seem to have been many, were evidently of the head and judgment and not of the heart. Genuine love of humanity was the chief characteristic of the man though carried in the view of many into ill-judged practice when it led him to pay the fines and thus unintentionally menace the community by turning loose criminals arraigned in the city courts.

Though sometimes wrong in their indi-

vidual methods, however, it must be conceded that the world has great need of such noble minded men as Mayor Jones, who are conscientiously and fearlessly groping toward the ideal demands of a true municipality.

Technical Meetings.

The annual convention of the New England Water Works Association will be held at Holyoke, Mass., Sept. 7, 8 and 9. Willard Kent, secretary, Narragansett, R. I.

The International Electrical Congress, under the auspices of the American Institute of Electrical Engineers, will hold a convention at St. Louis, Mo., Sept, 12, 13, 14, 15 and 16.

The eighth annual convention of the League of American Municipalities will be held at East St. Louis Ill., Oct. 4, 5 and 6.

Personal Notes.

Hugh B. Raines has resigned as city engineer at Dallas, Tex.

C. M. Miler has been elected city engineer at Salisbury, N. C.

Edward Kuhlman has been appointed village engineer at West Allis, Wis.

The Hon. Charles E. McLean. Mayor of Mobile, Ala., died July 11, aged forty years.

Mr. John Johnston, former Mayor of Port Huron, Mich., died in Chicago, recently.

J. L. Grant has resigned as superintendent of the water department at Auburn, N. Y.

J. J. Albertson of Camden, N. J., has been appointed borough engineer of Haddon Heights, N. J.

Burr M. Maulding has been appointed assistant civil engineer in the sewer department at St. Louis, Mo.

Col. R. H. Adams has resigned as superintendent of water works at Decatur, Ala., and L. B. Wyatt has been appointed his successor.

Louis Terven, E. E., has been appointed chief electrician of the Nernst Lamp Co., Pittsburg, Pa.

Dwight A. Harris, superintendent of the water department of New Britain, Conn., died June 16 from gunshot wounds inflicted with suicidal intent.

Mr. Robert Finch, president of the city council at Toledo, O., succeeded Hon. Samuel M. Jones as Mayor of that city.

Waddell & Hedrick of Kansas City, Mo., have opened offices in Toronto and Montreal, Canada, with the De Lano-Osborn Engineering Company as its representatives.

W. B. Bryan, chief engineer of the East London Water Company, has been appointed chief engineer of the Metropolitan Water Board. He will have charge of the

Ernest Wilder Clarke of Flushing, L. I., N. Y., has been appointed by the Panama Canal Commission as engineer in charge of the sewerage and water works to be constructed in the city of Colon, Panama.

The Hon. George Hall resigned as Mayor of Ogdensburg, N. Y., July 2. Disagreement over finances with President Van Kennen of the city water board, who was upheld by the chairman of the finance committee, led to his resignation.

E. Dev. Tompkins, Assoc, M. Am. Soc. C. E., has resigned as resident engineer in charge of the New York office of the Trussed Concrete-Steel Co., and has been appointed manager of the Philadelphia office of the Columbian Fireproofing Co.

B. B. Lathbury, Assoc. M. Soc. C. E., who recently severed connection with the firm of Lathbury & Spackman of Philadelphia, has been elected president of the Alma Cement Company, with offices in the Land Title Building, Philadelphia.

Robert S. Jones, formerly on the engineering staff of the Metropolitan Water and Sewerage Board, Boston, Mass., has accepted a position as resident engineer on the improvement of the works of the Derry Water Company and Irwin Water Company, with headquarters at Greensburg, Pa.

Mr. A. L. Waterbury, who was at one time first vice-president and general manager of the Citizens' Telephone Co. of Houston, Tex., has accepted a position as general manager of the sales department of the American Conduit Co. Mr. Waterbury will have his headquarters at the Chicago office of this company, 1005-6 Manhattan building.

John Dadie has been appointed general superintendent of West Parks at Chicago, Ill., to succeed William J. Crooke, resigned; Capt. Fitznen, superintendent of Douglas Park; A. M. Crawford, superintendent of Union Park; George A. Fenn, chief electrician; Edward Lichtenberger, collector of special assessments; Edward Cowen, superintendent of Garfield Park, to succeed James Ferry.

W. E. Fulk, C. E., has been elected city engineer and superintendent of the municipal plants, at Decatur, Ind. Mr. Fulk has been actively engaged in the civil engineering profession for several years and served as county surveyor of Adams County, Indiana, from 1894 to 1900. At the time of his assuming the duties of this office there were no macadam roads in the county, but at the close of his third term the total aggregate estimate of this class of improvements amounted to about $1,000,000. The active manner in which he prosecuted this class of work resulted in his appointment by the governor of the State, as a representative to the National Road Congress conventions a number of times

MACHINERY AND TRADE

Cement Concrete Construction.

In the earlier methods of concrete construction wooden forms were built up and filled with concrete which was allowed to set and then the wood forms were removed, leaving a very rough finish. Then the idea of molding the concrete into blocks was brought forward, as the face could be ornamented or molded into any desired form or finish. Then followed the idea of molding these blocks hollow in order to save material as well as to make a dry and warm wall. It remained for a lumberman to perfect this construction and produce a concrete block which would afford a frost-proof and damp-proof structure. This was secured by a very simple and ingenious arrangement of two rows of air spaces, arranged so the openings in one row overlap the ends of the openings in the next row. The intervals or necks between the openings are entirely cut off so that there is no direct line of material passing through the wall at any point, thus cutting off the passage of frost or moisture through the wall. An accompanying illustration shows the arrangement of the blocks in the wall, and the lapping of the air spaces referred to.

This idea was worked out and patented by O. U. Miracle of the firm of Miracle & Miracle, formerly of Sioux Falls, S. D., and the patents and appliances for making this form of block are now owned by the Miracle Pressed Stone Company of Minneapolis. It has been the aim of this company to produce a machine for the manufacture of these blocks that would be inexpensive, simple and easy of operation, and something that could be handled by the yard man and a helper at odd times. The lumber yard is the natural outlet for this material and the profit naturally belongs to the dealer. If a contractor puts in one of these machines he immediately learns to buy his cement in car lots from the jobber instead of from his local dealer and in this way gradually commences to lean toward outside buying. Then the dealer always has plenty of help around and can make up a supply of these blocks at odd times, so that the cost for labor will be very small. The demand for this material for foundations alone will make it a profitable investment.

The business can be handled with small capital. Three men operating one of these small outfits by hand will turn out 120 to 150 blocks per day, and they can be sold in competition with common brick at $8 per thousand. The Miracle outfit includes plates for making plain, panel, rock and hammered face designs. The blocks are removed from the machine on wooden pallets, costing about 12 cents to 15 cents each and 250 to 300 are needed with an outfit.

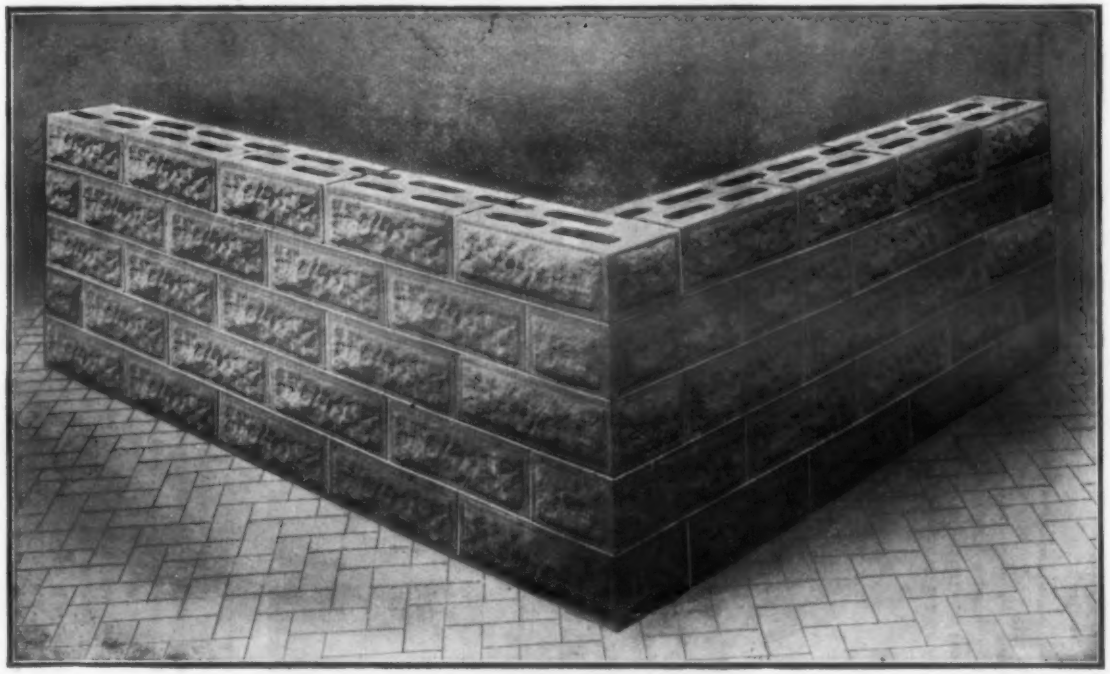
This block and wall were patented June 9, 1903, by O. U. Miracle and W. L. Dow, and are covered by letters patent No. 730,780. The main feature of the patent and the principal claim on which it is based is the simple idea of the staggered or irregular arrangement of the air spaces.

Branch offices have been established in Seattle, Duluth, Winnipeg, Pittsburg, Philadelphia, New York, Boston, Omaha and Chicago, and the home address is the Miracle Pressed Stone Company, Minneapolis, Minn.

Sand-Lime Brick Factory at Wilmington, Del.

The Diamond Stone Brick Company is rushing to completion its plant at Wilmington, Del., for the manufacture of sand-lime brick, and expect to begin operations within the next two or three weeks.

These brick are manufactured from the highest grade of silica sand and pure calcium lime. They are reported to stand a crushing strain greater than any clay brick, and a greater degree of temperature and the manufacturers guarantee a water absorption of less than 12 per cent. These brick improve with age in the atmosphere or under water, and will not crack or disintegrate by freezing. They can be furnished of any shade or color desired. The natural color, however, is a beautiful soft gray, resembling Indiana lime



WALL OF MIRACLE BLOCKS.
Patented June 9, 1903.

stone or sandstone. The Charles Warner Company of Philadelphia, Pa., and Wilmington, Del., will supply the raw materials for manufacturing the brick, and will have the general sales agency. Delivery can be made by water to New York, Philadelphia, Trenton and Camden, N. J.; Baltimore, Washington, Norfolk and Portsmouth, and via rail to intermediate points.

Bitulithic Pavement in North Carolina.

The Warren Brothers Company has just completed a contract for 12,000 square yards of the bitulithic pavement in Asheville, N. C., one of the best-known health resorts in the South. Asheville is famed for the relief it gives to persons afflicted with pulmonary disorders and in consequence the dozen large hotels in the place are filled with guests nearly the entire year, the health-giving atmosphere deriving its curative properties from the immense pine groves which surround the city. Asheville is also recognized as a city of more brick pavements than any other municipality of equal population in the United States.

WATER STREET, ASHEVILLE, N. C., BEFORE IMPROVEMENT.

Last winter, when the Warren Brothers Company began the work of laying 12,000 square yards of the bitulithic pavement in Asheville, N. C., the citizens were skeptical of the new material, their faith being in brick, although they realized and condemned its weaknesses. The past winter was one of unusual severity and before the contractors had completed laying the bitulithic intense cold made further progress impractical, not, however, until Flint-st., one of the thoroughfares included in the contract, had been finished and opened to travel. Under unusual conditions the tax-payers were given an opportunity to compare the bitulithic pavement with that to which they had been accustomed. The livery stable owners, who are reputed to own the finest line of horses for public hire to be found in the country, were among the first to congratulate the City Council upon their wise selection, as the new pavement under almost every weather condition was found to provide a sure and safe footing for horses, and injuries from falls on the bitulithic were unknown, an experience all too common on the other pavements.

When spring opened the bitulithic pavement did not show the least sign of the severity of the weather test to which it had been put and a peculiar circumstance served to increase, by comparison, the popular favor in which the Warren pavement was held.

The highway authorities had purchased two flushing machines and when spring weather made its appearance, these machines were brought into use to wash away the winter's accumulations on the surfaces of the pavements. The result of this innovation was injurious to the brick pavements which had been laid on a crushed stone foundation and sand

cushion. In places the sand cushion of the bricks was completely washed out and immediate repairs were required, and in other instances the surfaces of these pavements were very uneven. The bitulithic pavement was subjected to like treatment, but the effect was merely to remove the street accumulation, leaving the pavement pleasing to the eye, and safe to the foot of the most smoothly shod horse in Asheville. The wealthy citizens of Asheville were not slow in taking advantage of the practical object lesson taught them, and under their auspices a good streets movement was begun, which will result in a handsome boulevard. The present approach to the hotels from the railroad station is an unsightly one and makes a very poor impression upon visitors and tourists, as it compels traffic through an undesirable part of the city.

WATER STREET BITULITHIC PAVEMENT, ASHEVILLE, N. C.

The enthusiasm for better streets, inspired by the wealthy citizens, was infectious and was taken up by all classes of property owners, and in response to petitions for the bitulithic pavement on the part of residents of French Broad-ave. and Columbus-ave., the two handsomest thoroughfares in Asheville, the City Council has awarded to the Warren Brothers Company an additional contract for 25,000 square yards of bitulithic to be laid in these avenues.

Among the most ardent advocates of the bitulithic pavement is the chief engineer of the fire department, whose fire engine drivers have had some rather thrilling experiences on slippery pavements during the last few years, and he unhesitatingly says the drivers of the machines use the bitulithic pavement whenever possible, their horses appearing to know that it affords sure footing at top speed.

The High Point, N. C., City Council, after inspecting the bitulithic pavement in Asheville, has placed an experimental order with the Warren Brothers Company for 12,000 square yards.

The Open Shop Policy.

There seems to be a radical change of late in manufacturing methods among the largest and best manufacturers. Secrecy of methods used to be the rule, the doors were always closed to competitors and others, but wider and broader views seem now to prevail.

Last summer the E. R. Thomas Motor Company sent a number of their foremen to visit the finest factories of the country. They were instructed to make no attempts to obtain secret information, but to present their credentials at the office. Without a single exception they were cordially welcomed by the various officials and a free interchange of methods and ideas was made to the mutual advantage and profit of all concerned.

Among the visitors to the Thomas Automobile plants last week were ten of the

National Cash Register foremen, who spent the entire day examining the various fixtures and tools and discussing the various systems of construction.

The Thomas plants were recently visited by manufacturing representatives from England, Japan and China and students from Columbia and Cornell Universities and the Tech of Boston.

The Porcupine and Its Use.

Today the problem of road repair and maintenance is engrossing the attention of cities and country districts alike, quite as much as the subject of building new streets and roads. Macadam needs regular attention and frequent repairs and whether the mileage be small or great more efficient and economical methods of repair must be sought. Hand picking of macadam roads is expensive and unsatisfactory, as is also picking by means of picks in the wheels of a roller. Repairs attempted without picking up the old surface have been found worse than useless.

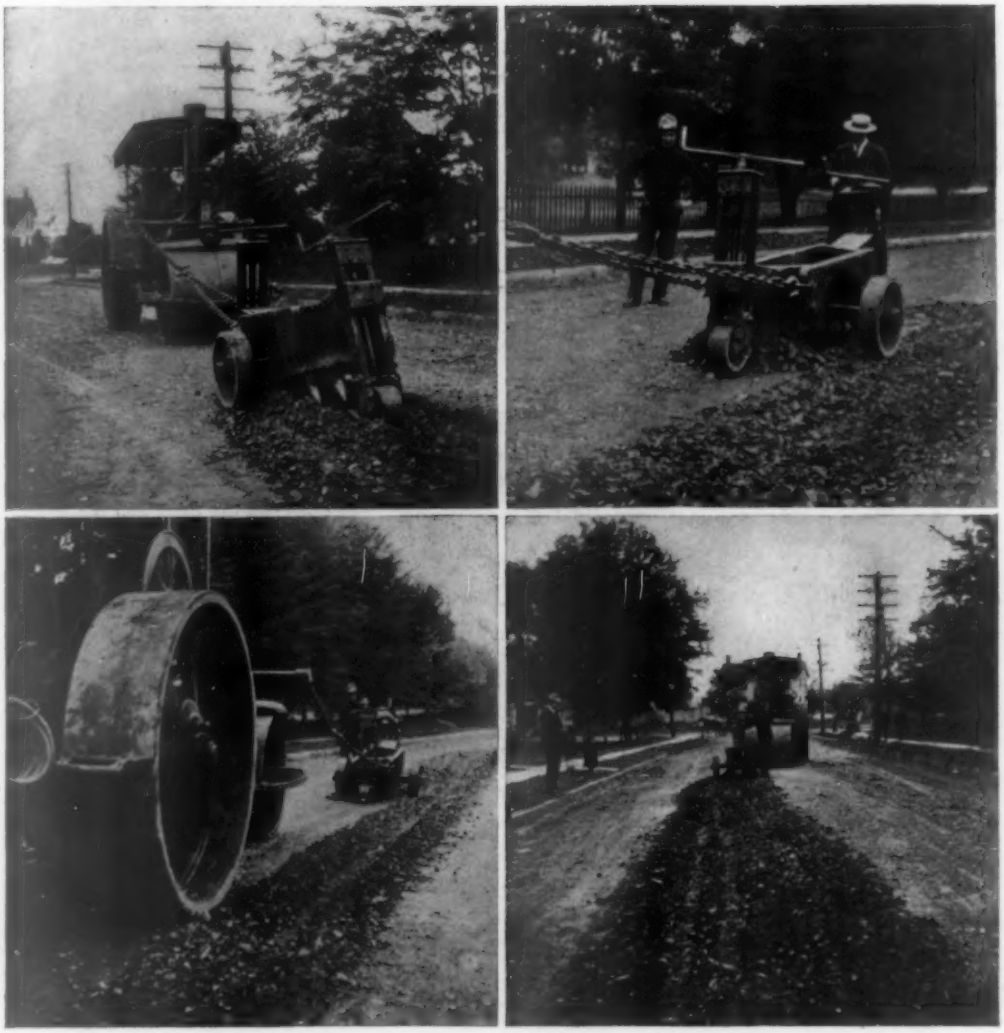
The Porcupine is a scarifier—a practical machine designed to simplify and cheapen the repair of macadam roads. Its weight is about 4,000 lbs. It will break up the surface of the hardest macadam in a uniform manner to a depth that will remove ruts and permit of reforming the street. The further simple process of rolling the surface, either with or without the addition of new crushed stone, is then sufficient to make the street as good as new.

The Porcupine loosens and separates the particles of the road surface without breaking the pieces of crushed stone composing it. The accompanying views illustrate the whole operation. No belt power or mechanism is required to operate the Porcupine. It is simply pulled by a steam roller or similar machine. An eight to ten ton steam roller is powerful enough to do the work. Attachment to the roller is made by a chain and the machine can be attached or detached in a moment.

THE PORCUPINE IN POSITION.

The roller draws the Porcupine to the end of the length of street being repaired, then laps over and draws it back again. At every pass the road is thoroughly loosened to the width of the Porcupine. If desired the street can then be harrowed in order to form up the crown, and afterward rolled down, the addition of fine stone and dust as a top dressing and the use of sprinkler in the usual manner, giving a new street, perfect in every way. The expense is so low that it pays far better to do this than to attempt repairs in any other way.

The machine can be regulated by one man. It follows straight and true. There is no jumping about or switching from side to side. The depth of scarifying can be regulated while the machine is in



FOUR VIEWS OF THE PORCUPINE IN ACTION.

operation. It will perform its work moving in either direction.

As a reasonable example of what can be done in one day with this machine in connection with a steam roller, one Porcupine has scarified one block of the

THE AUTO-ARC LAMP.

hardest city street that could be found, and the surface was then shaped up and rolled down again, the whole being completed between the hours of 10 a. m. and 6 p. m. with the labor of four men. This represents an average day's work of an outfit consisting of a Porcupine in connection with a steam roller. If we speak of the amount of surface that might be scarified in one day, the machine will thoroughly loosen in ten hours 4,000 square yards.

The machine is a wonder to all who have seen it work. In the hardest macadam it is as steady as an ordinary plow in soft ground. Not only can the depth of the spikes be regulated for scarifying purposes, but they can be easily raised to go over crossings, etc. Scarifying can be done close up to the gutter or curb.

Where trenches for sewers are being cut the Porcupine can be used for removing the top surface, thus saving a great deal of hard picking. When it becomes necessary to either raise or lower a roadway, the Porcupine is very useful.

Any one who has seen the Porcupine work will testify that it scarifies a road better than is possible by hand labor or any other method. It is specially advantageous, in the opinion of experts, where a road requires reshaping and only a small addition of new crushed stone.

The wear and tear of the spikes is not great and when necessary they can be readily sharpened at small cost. A new set can be put in at a moment's notice.

Julian Scholl & Co., 126 Liberty-st., New York City, will give further information about the machine and its operation.

The Auto-Arc Lamp.

The accompanying photograph shows the latest development of the auto-arc lamp of the Automatic Incandescent Light Company, Northboro, Mass. This 1904 model is specially artistic in form and in manner of support. The lamp is of oxidized copper on the outside and is rustless, improving in color with age.

The lamp is raised and lowered by means of a small crank carried in the pocket, which is put on the end of the shaft of a roller whose bearings are in the upper part of the largest section of the post. A cable attached at one end to the lamp and at the other to a counterbalance weight is given a double turn about this roller, and the cable runs on pulleys around the gooseneck at the top of the pole. The whole is so neatly adjusted that a crank handle six inches long gives sufficient leverage to handle the lamp.

The lamp can be lighted by holding a torch to a fixed point on the lamp for a few seconds, and as this torch can be

on the end of a pole of suitable length, it can be lighted without lowering, if so desired.

The candle power of the lamp is equal to that of the electric arc, and the lamp has supplanted electric lights in several places with very satisfactory results. In Milford, Mass., they are burning in competition with electric arcs. Groton, Mass., has ordered a quantity and Charles River and Norumbega Parks are using the lamps in large numbers, the former using them exclusively and the latter for auxiliary lighting. The Automatic Incandescent Light Company, Northboro, Mass., issues descriptive circulars of the system, and of the construction of the lamp and will give further details. Independent lights are in very many cases the most satisfactory and such satisfactory designs as the present one, in appearance, operation and candlepower, not only dominate their own particular field but compete successfully with gas and very often with electric lights.

STEEL BELT CONVEYOR.

Triumph Steel Belt Conveyor.

The accompanying cut illustrates the Triumph steel belt conveyor designed to take the place of rubber or gandy belt conveyors. It is made entirely of iron and steel and the manufacturers say it will last ten times as long as any rubber or gandy belt conveyor. It can be made of almost any size and almost any length desired, requires very little power to drive it and is especially adapted for conveying large quantities of ore, coal, crushed stone, clay, marl, castings and similar materials. As an ore or coal sorting table it has no equal on account of its slow speed, large capacity and durability. The material can be discharged at any place by the discharge plow or it can discharge at the end.

The conveyor is constructed of one strand of special chain, 24-inch pitch, with a working strain of more than 10,000 pounds, fastened together with special steel pins with self-oiling rollers at each end, which run on a steel track, usually supported on cast iron stands, although wood supports can be substituted if desired. There is a steel sprocket wheel at each end securely fastened to steel shafts. At the front end are heavy stands with take-up boxes. The drive end has steel countershaft with heavy gears and drive pulley. On each link is fastened a special saddle atttachment for supporting the steel belt which is made in sections 24 inches long and wide enough to give the required capacity, and all bent in a concave or troughing form (it can be straight if desired), one end being securely fastened to the special saddle attachment, the other end so fastened as to move forward and back, allowing it to pass around the sprockets at the end. These pieces of steel thus form a continuous steel belt or troughing conveyor. The C. O. Bartlett & Snow Company of Cleveland, O., are the manufacturers.

Hollow Concrete Block Architecture.

The Harmon S. Palmer Concrete Building Block Company of Washington, D. C., owner of the pioneer machine for

making hollow concrete building blocks, has issued a handsome and expensive book of photographs showing buildings constructed with blocks made on its machines. The buildings shown are located in all parts of the country from Washington, D. C., to Colorado, and Florida to Wisconsin. The pictures show that handsome architectural effects are readily attainable if proper attention is paid to this important matter, and a few of them show that concrete blocks, no matter how good, cannot overcome the ugliness of a poorly designed building or one built without design or without reference to the character of the material used. The fact that such very satisfactory architectural effects can be obtained as are shown in most of these pictures demonstrates the proposition made in several recent articles in Municipal Engineering, that concrete block construction on proper lines is applicable to buildings which would otherwise be constructed of fancy brick or expensive stone.

This company has recently obtained a perpetual injunction against Spayd, Bennett & Co. of Owensboro, Ky., stopping their manufacture of blocks which infringe upon the H. S. Palmer patents.

Cement Brick by the Bowen Process.

The Western Brick Company, 20 N. Fifth-st., Keokuk, Ia., is proposing to install plants for the manufacture of brick of sand and cement, using a formula devised by R. H. Bowen, the general manager of the company, to hasten the setting of the mortar, with the expectation that the brick can be handled in twenty-four hours after making and can be used in forty-eight hours. It has been practically demonstrated that cement bricks can be made for less money than clay brick and their manufacture requires a much smaller and less expensive plant. One of the Bowen presses will make 20,000 brick a day.

The Studebaker Banner Dump Wagon.

The Studebaker patent "Banner" Dump Wagon is designed for city contractors' use, for hauling cobble stone, brick, gravel, crushed stone, wet or dry clay, asphalt, macadam and all kinds of paving materials. The box is square, smooth and clear of any obstructions on the inside. The trap and chain devices by which the doors are operated work together on the outside; consequently when the doors are released or opened the load is dumped completely, nothing remaining in the box.

THE BANNER DUMP WAGON.

The wagon is also especially adapted for spreading crushed stone or other materials to any desired quantity. The doors when released automatically lift and fold against the outside of the box, so that when the contents are dumped the wagon cannot be stalled as a result of the doors being caught in the material dumped. An extra lever, or friction pulley attachment is placed at the front end, whereby the trap doors can be regulated to spread the load over the ground as desired.

Other features are the hinged top boards, which expedite the loading of the wagon by shovel from the ground, and

the chain and hook attached to rear end of wagon, for trailing purposes.

These features render the "Banner Dump wagon of the greatest service in asphalt or macadam street paving and will commend it to contractors in street work generally.

Hound front gear, with either neck yoke or chain pole. It has the oscillating fifth wheel, which will allow the front wheel on either side to drop into a depression in the roadway without disturbing the level of the body. Gear is painted red, body green. Can be furnished, at extra cost, with brake, steel lining, steel and asbestos lining.

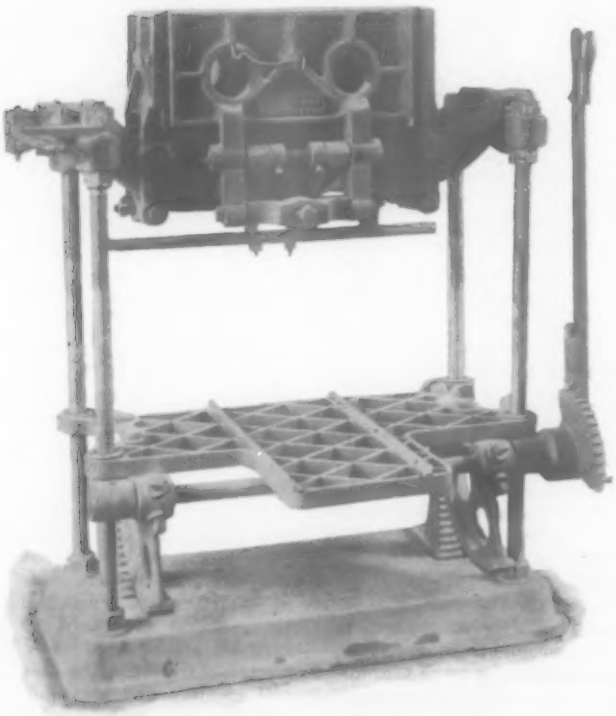
BRAZIL CEMETERY ENTRANCE.
Artificial Stone Blocks made by Pettyjohn Machine.

A Cemetery Entrance of Hollow Concrete Blocks.

Of all the various cement industries, none of them have made such vast strides or attracted so much general attention as the manufacture of hollow concrete building blocks. Three years ago but little was known of the hollow block, but the growing scarcity of lumber, together with improvements in the methods of manufacture, and a more thorough knowledge concerning the use and abuse of cement, have pushed it forward with incredible rapidity. The handsome face designs that are sent with most of the modern machines make an artistic effect in the way that appeals to the architect, to the builder and to the owner. The ease with which special shapes or ornamental designs are made, and the fact that when the forms are once made exact duplicates can be turned out with great rapidity, have greatly cheapened the cost of the concrete building. Much of their poplarity is due to the ventilated wall which forms an air chamber and tends to make the buildings cool in summer and warm in winter.

Many different processes of handling the material are still in vogue and the wonder is that such excellent building material can be made by so many different methods, but the tendency is always for "the survival of the fittest" and, no doubt, in time there will be more uniformity in the methods of manufacture. Some claim that the wet process is correct, others say dry and still others say that neither of these is correct—that the blocks should receive sufficient moisture at first to start crystallization and that they should afterward be sprinkled as crystallization progresses. Again, some manufacturers use the machine in a central location and move the blocks away on iron pallets, while others leave the blocks where they are made, and move the machine itself, claiming that con-

COTTOM ARTIFICIAL STONE FACTORY.



COTTOM ARTIFICIAL STONE MACHINE.
Ready to make a block.

crete should not be disturbed after it is moulded or while it is setting.

How these various details will be decided time alone will tell, but one thing is certain, that the concrete block is here and here to stay, and that the most handsome architectural effects combined with the most durable material will continue to make this industry grow in importance. We believe that at no distant day every little village will have its hollow block factory, as the initial cost of such an enterprise is comparatively small and the returns for intelligent effort seem to be invariably satisfactory.

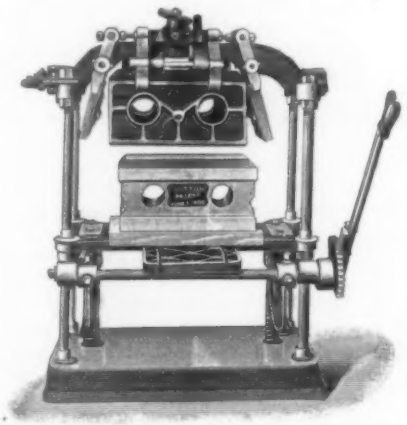
As an illustration of what can be done in this direction a cut of a very handsome arch at the entrance of the Cottage Hill Cemetery, Brazil, Ind., is presented. The stones for this arch were made, cured, laid in the wall and the completed structure turned over to and accepted by the cemetery committtee, all in two weeks time after the contract was signed. The structure was erected by Cutshall & Flagg, contractors and stone manufacturers, of Brazil, Ind. They used the Pettyjohn machine, made in Terre Haute, Ind., and at the time of building the arch they had only one machine and had been in the block manufacturing business for only about one month.

The Cottom Machine for Making Artificial Stone Blocks.

The accompanying photograph shows the building of the Cottom Artificial Stone and Manufacturing Company at 40 Potomac-st., Dayton, O., which is built of concrete blocks, made on the Cottom machine; also a picture of the machine, showing in upright position the revolvable flask for making the blocks, supported on steel posts, and a platform which can be raised or lowered by throwing a lever.

In the process of making a block the mold is set upright, the face of the block being at the bottom. It is then tamped full of concrete and the back face of the block is flush with the top of the mold in this position. A wooden pallet is fastened upon it and the mold is then revolved and a movable platform is moved up to the pallet under the mold; all the sides and ends of the mold are moved on their hinges by a single motion, and the block is thus transferred to the pallet, as shown in the small accompanying cut. The block is then lowered and carried away to the curing shed. The sides of the mold are fitted to receive cores for making hollows which, when in place in the wall, form vertical air flues. The ends of the blocks are formed with grooves, which are vertical in the wall formed of the blocks, and these openings are filled with a semi-liquid cement in laying, thus forming dowels or bars which hold the blocks in position. There are also horizontal "mortar beds" between the blocks, which are filled with cement, binding the wall into a solid mass.

The standard block is 18 inches long, 8 inches high and 9 inches thick. Half blocks, corner, return corner, angle, curved, joist and window blocks are also made on the machine with either smooth or rock face. The blocks are laid with close joints and no pointing up is required. They are so beveled that the edge is protected from injury in handling. They can be handled by one man.



COTTOM ARTIFICIAL STONE MACHINE.
Completed block just discharged.

The daily capacity of the machine is from 100 to 150 blocks a day. The Cottom Artificial Stone and Manufacturing Company of Dayton, O., holds patents covering the novel points in the machine, the blocks and the manner of laying.

Cement Catch Basin Machines.

The Jackson Cement Sewer Pipe Company, Jackson, Mich., are the patentees of a machine which produces an entire catch basin of cement concrete by a single operation—not only the straight lower portion, but the arch at the top as well—all complete and in one solid piece. Cement is rapidly taking the place of wood, brick, stone, steel, etc., for all building purposes and it is now used in

sewers and catch basins. All the large railroads are building their bridge abutments, piers and culverts out of cement, and the government is using it for locks and dams, in preference to other materials.

This company also makes a machine for the production of cement sewer pipes and water conduits. Their sewer pipe machines will make pipe of any diameter and in sections of convenient length, which, after being laid in position and the joints "tied" and cemented according to their special system, form a continuous pipe of solid cement concrete. There are also great advantages in the use of cement for conduits for municipal water supply. Cement pipes carry the water with less friction, they form no sediment, permit of greater flow of water and keep the water pure. Cement water conduits are made and installed in exactly the same manner as the cement sewers. The Jackson Cement Sewer Pipe Company is a large manufacturer of cement sewer pipe, catch basins, water conduits, etc., and is in position to fill orders promptly for this product or furnish machines for the manufacture thereof. They issue an illustrated catalogue.

An Inexpensive Concrete Mixer.

Many contractors and makers of concrete blocks feel the need of a machine for mixing concrete, but their business will not warrant the purchase and operation of the ordinary machines on the market. Mr. F. A. Sicklesteel, C. E., of North Branch, Mich., has devised a batch mixer which does not infringe any patent and can be made by any good mechanic. He has made plans and specifications for its construction which he will furnish to any one for $2. It is made principally of wood, costs but little and has a capacity of five cubic yards an hour with two horsepower.

A batch mixer can be run until the mixture is perfect, and the first cost of this one is so small that any small user of concrete will find its use convenient and economical. Write to Mr. Sicklesteel for further details.

Machine for Pulling Cement Curb Templates.

The withdrawing of templates from cement curb and gutter work by hand is a difficult task, and results in more or less injury to the cement, which adheres to both sides of the template. No engineer or contractor needs to be told that when cement is broken or cracked after once having been set it is permanently injured. Such injury is done to every joint when the templates are withdrawn by hand

A piece of apparatus invented by A. H. Kennedy of Rockport, Ind., entirely obviates any such injury and leaves the joint as perfect as any other part of the job. It consists of three parts, viz: Two feet shaped so as to fit the curb and gutter and placed far enough apart to receive the template when it is withdrawn; a screw that runs through a nut securely fastened to the two feet and down through channels cut in them; a yoke with stirrups at each end having hooks to engage with the two ears of the template.

The operation is as follows: Place the machine in position, with the screw run down to the nut, adjust the hooks to the ears of the template, then back out the screw until the template is removed.

The tighter the template sticks to the cement the more firmly the feet are pressed down upon the cement on both sides of the template; this makes it impossible to do any injury whatever to the cement. The operation is very expeditious, as the template is withdrawn in less time than by hand and no patching up of the joint is required. The machine is before the patent office and the principles above outlined will be amply covered by patents, which have been applied for.

Trade Publications.

The Stanley Electric Mfg. Co., Pittsfield, Mass., issues a catalogue giving a synopsis of the S. K. C. system, and describing the apparatus included therein, such as condensers, circuit breakers, frequency changer, fuses, generators, meters, lightning arresters, motors, rheostats, switches, transformers, etc.

Power and Transmission celebrates the beginning of its twentieth volume by moving to Chicago, 335 Dearborn-st., and becoming a monthly publication of standard, 6x9, size, with 16 pages and cover. Typographically and editorially it returns to its first principles and bids fair to keep up its former good reputation in both these directions.

The H. W. Johns-Manville Co., New York, have just issued a neat and complete catalogue covering "Mica" Plate, Cloth, Segments, Ring and Mica in all its various forms required by the Electrical

industry, also "Vulcabeston," "Transite," "Electrobestos" and "Niagrite." A copy can be had by addressing them, 100 William-st, New York.

Jeffrey water elevators are listed in special price list No. 62 of the Jeffrey Mfg. Co., Columbus, O.

Trade Notes.

ASPHALT.

The asphalt plant of the American Asphalt-Mastic Company, at Alma, Mich., is about completed and the work of manufacturing will begin as soon as the machinery is in place.

The plant of the Uvalde Asphalt Company, occupying the block bounded by Essex, Green and Hudson-sts. and the Morris and Essex Canal basin, in Jersey City, N. J., was destroyed by fire July 14, entailing a loss of $150,000 to $200,000.

Gen. Samuel T. Carnes and associates have made arrangements to purchase the plant of the Central Asphalt and Refining Company at Port Neches, Tex., when it is sold at auction Aug. 2. The plant will be refitted at considerable expense.

The Sixtieth district court at Beaumont, Tex., rendered an agreed judgment June 29 in the case of the Texas Company vs. the Central Asphalt and Refining Company. It was decreed that the plaintiff should recover of the defendant $10,000 with interest and costs, full settlement and liquidation of a claim of the plaintiff against the defendant for 48,067.53 barrels of crude petroleum oil at 15 cents per barrel delivered by the defendant company. It is also provided that the plaintiff shall execute a release of its lien against the plant and oil tanks of the defendant and shall cause an order to be decreed settling and dismissing the case against the Central Asphalt and Refining Company without impairing the plaintiff's claim against the right to sue the Export Oil and Pipe Line Company.

The Indian Asphalt Company, Railway Exchange Building, Chicago, Ill., sends samples of its products, gum asphaltum for paving and other uses, a sheet of water-proofing of the same composition and a black asphalt paint. This company manufactures such products from Indiana oil with asphaltic base and is also agent for similar products manufactured by the various refineries of California oil and asphaltum which are included under the California Asphaltum Sales Agency. In view of their very high degree of purity and their good qualities these products are worthy of the careful attention of engineers and others using this class of materials.

BRICK.

The Muskogee Vitrified Brick Company, Muskogee, I. T., will add a paving brick department to its plant. W. J. Lanston, genl. mgr.

The Coffeyville Pressed Brick and Paving Brick Company, Coffeyville, Kas., has been reorganized as the Park Brick Company, with G. H. Park of Beaumont, Tex., as general manager.

The American Sand-Lime Brick Company, 1306 Great Northern Building, Chicago, has been awarded the contract for a large sand-lime brick plant for Coney Island, N. Y.

CEMENT.

The Consumers' Gypsum Company, Port Clinton, O., has been organized by Pittsburg capitalists.

The Round Top Cement Company, Bloomfield, N. J., has been incorporated by Joel Jenkins, James H. Leonard and Percy Allen.

The Southwestern Cement Company, Ferguson, Okla., has been incorporated by George Newer, J. B. Scott, E. A. Cox and F. E. Blanden.

The American Portland Cement Company, Kansas City, Mo., has been incorporated by C. A. Brockett, Howard McCutcheon, P. R. Jordan and R. M. Brockett.

The Crescent Cement Company, Chicago, Ill., has been incorporated for the purpose of manufacturing cement, by George Williams, Frank W. Welch, Sidney B. Merrill.

The Columbia Portland Cement and Marl Company, Madison, Wis., has been incorporated by John C. Prien, William H. Williams, C. A. Van Velzer, C. C. Wayland, Enoch Vernon, John Waterman and F. H. Merrill.

The cement plant of Judge Aldrich at Edgewater, Mich., will be transferred to Charlevoix County according to press reports, and a cement plant will be built on 500 acres of land containing limestone and shale.

The American Brick, Cement and Tiling Company has been incorporated under New Jersey laws by Joseph L. Sackman, Heinrich Mielck and Alfred Hamilton. The concern is a foreign one and the New Jersey Registration and Trust Company

A swamp and lake has been discovered in the town of Eagle, Wis., by William H. Lindwurm, jr., of Milwaukee and Lawrence Fardy of Eagle which contains a very fine quality of lime marl, and a plant for the manufacture of Portland cement will probably be established.

The United States Portland Cement Company, with works and factory at Bedford, Ind., and principal offices at Indianapolis, has been organized with the following directors: Elbert Walker Shirk, Emanuel I. Fisher, Frank M. Talbot, Abraham Lehman and Vanton O. Foulk.

In a bill asking for the appointment of a general receiver for the Hecla Portland Cement and Coral Company at Bay City, Mich., and that the plant be put in operation under the receivership, U. R. Loranger, former secretary and manager of the company, has made an offer to furnish the money to make alterations necessary in the machinery and operate the plant. About $50,000 is necessary to place the plant in working condition.

of East Orange is its local legal representative.

The Mayo Brick and Tile Company, Walhalla, N. D., contemplates engaging in the manufacture of natural cement at an early date.

The Lakefield Portland Cement Company, Lakefield, Ont., and the Canadian Portland Cement Company, Strathcona, Ont., secured the contract for furnishing 14,000 barrels of cement each for the Trent Valley canal.

The Sun Portland Cement Company, Owen Sound, Ont., contemplates changing from the dry to the wet process.

The Manawa Portland Cement Company, Manawa, Wis., has been incorporated by Enoch Vernon, C. E. Holman, Neil Gunsten, G. O. Knosten and C. H. Anderson.

The Inter-Ocean Portland Cement Company, recently organized, contemplates developing the rock near Ft. Assiniboine, Mont., analysis of which show it to be of the right proportion for the production of good cement.

J. M. Williamson of Bloomington, Ill., has a very convenient piece of apparatus for forming cement curb and gutter, the surface coat on the entire curb and gutter being made to proper form by the "former" in the hands of a single man.

CONCRETE BLOCKS.

The Indiana Concrete and Construction Company, Indiana, Pa., has been incorporated by A. E. Orr, John R. Richards, J. H. Engle, —— Campbell and John A. Scott of Indiana, and W. H. Morris of Johnstown, Pa. The company will manufacture hollow concrete building blocks. The process of H. S. Palmer of Washington, D. C., will be used.

A concrete building block plant is being installed at Stoyestown, Pa., by Messrs. Morris and Zimmerman. The officers of the company are as follows: President, Josiah Specht; secretary and treasurer, Dr. J. H. Gardner; directors: Jerome Stufft, H. F. Barron, E. C. Welsh and Sherd P. Zimmerman. The process controlled by H. S. Palmer of Washington, D. C., will be used.

The San Jose Cement Block Company, San Jose, Cal., has been organized to manufacture cement concrete building blocks. A plant will be erected.

The Barber Asphalt Paving Company, Des Moines, Ia., is having plans and estimates prepared for putting in machinery, buildings, kilns, etc., at its south side brick plant for the manufacture of hollow building blocks for fireproofing, construction work, etc.

The Morriss Hollow Concrete Block and Construction Company, Granite City, Ill., has been incorporated to manufacture hollow concrete blocks by A. W. Morriss, Ralph A. Morriss and Vernon S. Morriss.

The Davenport Cement Sidewalk Company, Davenport, Ia., has been organized by N. C. Martin and James Lamb and will manufacture cement and granitoid sidewalks, cement blocks, step and wall copings, carriage blocks, cement footings, retaining walls and granitoid or cement floors.

The Decatur Cement Roof and Block Company, Decatur, Ind., has been incorporated by J. B. Holthouse, Henry Hite and John Everett.

A plant may be established at Pierre, S. D., for the manufacture of cement blocks.

A plant is being established at Avoca, Ia., by Charles Schmidt, jr., for the manufacture of cement blocks and cement sidewalk blocks.

A cement block machine has been installed by Wimmer & Williams of Perry, Ia., and a specimen building will be erected by Mr. Williams to show the appearance of a building constructed with these blocks.

A plant for the manufacture of hollow cement building blocks has been added by C. S. Session of Palmyra, N. Y., to his contractors' supply business.

The Jordan Lake Sand Company, Lake Odessa, Mich., has purchased machinery and will engage in the manufacture of cement bricks.

A plant is being established at Omaha, Neb., by Jones & Crawmer for manufacturing concrete stone.

S. E. Kessler, Columbia City, Ind., contemplates adding machinery for the manufacture of cement blocks to his contractors' supply business.

The Hartford Concrete Block Company, Hartford, Conn., has been incorporated by James O'Laughlin of New Britain and John F. Conniff and Francis W. Howard of Hartford.

The Hydraulic Stone Mfg. Company, Muskogee, I. T., has been incorporated with officers as follows: President, J. O. Callahan; vice-president, A. E. Bonnell; secretary, B. G. Slaughter; treasurer, D. H. Middleton.

The Kankakee Pressed Stone Company, Kankakee, Ill., has been incorporated to manufacture cement building blocks, by R. G. Risser, W. Smith and George Carson.

The Decatur Litholite Stone Company, Decatur, Ill., will be incorporated to manufacture concrete building blocks by W. H. Hilton and J. H. Culver of Decatur and W. J. Kinney of Charleston.

The Hayden Automatic Block Machinery Company, Columbus, O., has been incorporated by William B. Hayden, Nathan B. Marple, Lemuel D. Lilly, Frederick W. Prentiss and Gebhard Jaeger. Machines for the manufacture of cement, clay building or paving brick will be made.

The Newark Artificial Stone and Plaster Company, Newark, O., has begun the manufacture of concrete building blocks. A. R. Pitser is president, J. A. McNamar vice-president, F. T. Mercer secretary and C. E. Cochrane treasurer.

A plant is being constructed by Thompson, Hubman & Fisher, Tonawanda, N. Y., for the manufacture of artificial stone for building purposes.

The Diamond Stone Brick Company,

Wilmington, Del., has been reorganized with the following officers: President, Charles Warner; vice-president, H. O. Duerr; secretary, Horace G. Knowles; treasurer, William T. White. A plant is being built for the manufacture of brick and artificial stone.

A plant is being erected by William Lough of Arcola, Ill., for the manufacture of hollow cement blocks.

A company is being organized by Alderman J. C. Smith of Rockhaven, Pa., for the manufacture of hollow concrete building blocks.

A plant has been established at Scranton, Pa., for the manufacture of hollow concrete blocks by Hon. John H. Fellows and J. W. Browning.

A plant is being erected at Terre Haute, Ind., by the Western Indiana Hydraulic Stone Company for the manufacture of concrete blocks. W. A. Staley, mgr.

The Maumee Cement Block Company, Toledo, O., has been incorporated by William J. McGarr and others for the manufacture of cement blocks.

The Waterloo Automatic Stone Machine Company, Waterloo, Ia., has been organized by Thomas Cascaden, jr., J. R. Vaughan, William Vaughan, C. B. Hubbard and others. The company will manufacture a machine, the invention of William Raab, which operates with compressed air.

LIGHTING AND POWER.

The Frederick Gas Company and the West End Gas and Electrical Company, Frederick, Md., were merged July 1 under the name of the Frederick Gas and Electrical Company.

The Grand Lodge Electric Power Company has been organized to build and acquire water power and supply electric power at and near Grand Lodge, Mich. E. C. Jarvis of Lansing, Joseph H. Bootes and Glen D. Smith of Jackson are interested.

The Monarch Manufacturing Company, Portland, Me., has been incorporated to conduct an electrical engineering business, with officers as follows: President, Millard W. Baldwin, Portland; treasurer, George C. Knight, Portland.

Lighting companies have beeen incorporated as follows: Burke Electric Company, Jersey City, N. J.; Poudre Valley Gas Company, Ft. Collins, Colo.; Independent Gas Company, South Bend, Ind.; New York and Westchester Lighting Company, Port Chester, N. Y.; Bennet Company, Omaha, Neb.; Saybrook Electric Light, Heat and Power Company, Saybrook, Ill.; New York and Queens County Gas Company, New York City; Pembroke Light, Power and Water Company, Pembroke, N. Y.; Miller Electric Company, Newark, N. J.; Potomac Light and Power Company, Baltimore, Md.; Despatch Heat, Light and Power Company, Despatch, N. Y.; Decatur Light and Power and Fuel Company, Decatur, Ala.; Muncie Gas Light and Fuel Company, Muncie, Ind.; Bennington Gas Company, Bennington, Vt.; Gillespie Electric Light Company, Gillespie, Ill.; Lebanon Electric and Power Company, Lebanon, Mo.

The Comfort Gas Appliance Manufacturing Company, Augusta, Me., has been incorporated with I. L. Fairbanks as president.

MISCELLANEOUS.

The Affleck Concrete Steel Tie Co., Jersey City, N. J., has been incorporated by Louis B. Dailey, Joseph M. Mitchell and Thomas H. Haggerty.

The American Turbine Engine Co. has been organized at Portland, Me., for the purpose of manufacturing and dealing in turbine and other engines, with officers as follows: President, Martin S. Watts, New York City; treasurer, Charles S. Marston, Yarmouth, Me.

E. W. Oakes of West Bay City, Mich., has been granted a patent on a nozzle to be used in fighting fire.

The Carey Construction Co. has been incorporated at Cleveland, O., with offices in the Society for Savings building. J. D. Carey, cement contractor, is at the head of the company.

A petition in involuntary bankruptcy has been filed against the Eastern Construction Company at Buffalo, N. Y., by the Commercial National Bank of Chicago, which alleges in its petition that its claim is $3,000 and interest. The claim is based upon a note dated Feb. 5, 1904. It was drawn by the Eastern Construction Company and made payable to the Federal Asphalt Company of Chicago. The note was indorsed by the Federal Asphalt Company and transferred to the bank. It fell due on May 5, 1904, and went to protest. The Federal Asphalt Company, it is claimed, is parent of a number of companies similar to the Eastern Construction Company, and its stockholders are largely holders of the stock of the local company; also that Frank V. E. Bardol, ex-City Engineer of Buffalo, who is president of the company, was the only person who actually put money into the plant. The act of bankruptcy alleges that the Eastern Construction Company on April 26, 1904, while insolvent, permitted its president to secure a judgment against the corporation, and upon that judgment an execution was issued, the plant of the company was sold and purchased by Mr. Bardol for a nominal sum of money, thus defeating other creditors from participation of its assets. The amount of the judgment secured against the Eastern Construction Company was between $18,000 and $19,000, and was for money advanced. The sale, it is claimed, realized about $1,000.

The Osage Stone and Cement Co., Clinton, Ia., has been incorporated to manufacture crushed stone.

The Trussed Concrete Co., Detroit, Mich., has been awarded a contract for steel bars amounting to $26,000, to be used in the construction of the academic group of buildings at the United States Naval Academy at Annapolis, Md.

The United Sewerage Co., New York City, has been incorporated by Ralph C.

Lupton, C. A. Darby and S. F. Caursen.

The Alliance Brace and Tool Co., Alliance, O., advises us that it has disposed of its business to the Duff Manufacturing Co. of Pittsburg, Pa., manufacturers of the "Barrett Jack."

The Springfield Paving Company, Springfield, O., was incorporated July 6 by Edward M. Ryan, M. F. Bramley, P. R. Quinlan, F. L. Taft and C. W. Wagner. The company will manufacture paving and building blocks, etc.

The Toledo Development Company is preparing to install the Edson system of garbage reduction in the cities of Toledo, Dayton and Marion, O., the two former cities to have sixty-ton plants and the last one of twenty tons capacity, operated by the city.

The United States Drying Engineering Company has recently closed contracts for the installation of two large begasse dryers in Cuba, two dryers for the drying of clay, one large peat dryer, a plant for the drying and handling of infusorial earth and also has in hand an export order for Australia for the drying of fertilizer products.

IMPROVEMENT AND CONTRACTING NEWS

PAVING.

Palouse, Wash.—Macadam paving is proposed for Main-st.

Moorhead, Minn.—The principal business streets will be repaved.

Castana, Ia.—The construction of permanent sidewalks is proposed.

Chattanooga, Tenn.—Williams-st., in South Chattanooga, will be paved.

Knoxville, Tenn.—The question of paving Asylum-st. is being considered.

Little Rock, Ark.—Street improvements are proposed for Pulaski Heights.

Glendive, Mont.—Paving is contemplated for Merrill-ave., Bell and Town-sts.

Upper Alton, Ill.—Paving is contemplated for Liberty-st. as far as the public park.

Oakland, Cal.—City Council has adopted the estimates of City Engineer Turner for paving a number of streets.

Astoria, Ore.—An ordinance was passed July 5 for paving Duane and Third-sts. with macadam, with cement sidewalks

Oelwein, Ia.—An ordinance has been passed providing for brick paving on Fifth-ave. from S. Market to S. First-sts.

Dayton, O.—A resolution was adopted July 15 for paving Broadway-st., from Third-st. to Wolf creek, with gravel.

Sedalia, Mo.—The property owners on Osage-st., from the railway tracks to Fourth-st., will petition for vitrified brick paving.

Buffalo, N. Y.—(Special).—Ordinances have been adopted for paving a number of streets with asphalt and other material.

Appleton, Wis.—Plans are being prepared for paving Oneida-st. with asphalt, tar macadam or Kettle river sandstone.

Centralia, Ill.—An ordinance was passed July 5 for paving the streets in the business section of this city with brick.

Columbus, O.—Resolutions were passed July 18 providing for the repair of portions of High, Broad, Fourth and Long-sts,

East Lake, Ala.—This place will vote Aug. 15 on the question of issuing $12,500 bonds for street and sidewalk improvements.

St. Joseph, Mo.—An ordinance has been passed to pave Twenty-fourth-st., from Felix to Clay-sts., with brick. John C Landis, president B. P. W.

Boise City, Ida.—The construction of cement sidewalks is contemplated on a large number of streets. H. W. Clement, cy. clk.

Rockwell City, Ia.—The town council has passed an ordinance requiring all sidewalks around the public square to be of cement.

Lorain, O.—The property-owners on Seventh-ave., between Broadway and Long-sts., have petitioned for asphalt paving, instead of brick.

Albany, N. Y.—An amended ordinance will be passed for paving Ten Broeck-st., between Livingston-ave. and Colonie-st., with granite block.

St. Paul, Minn.—Final orders have been sent to council by the bd. of pub. wks. for paving W. Third-st., from Wabasha-st. to Seven Corners with asphalt.

Tacoma, Wash.—Ordinances have been passed providing for the paving of C-st., Yakima-ave. and a number of other streets with asphalt, macadam or other material.

Brookville, Ind.—The town board of trustees have taken preliminary steps for improving the sidewalks on Main-st.

K. L. Hanson of Connersville is making surveys.

Brooklyn, N. Y.—Martin W. Littleton, borough president, will ask for an extra appropriation of $1,000,000 to repave cobblestone streets with asphalt or granite

Chardon, O.—Paving is contemplated for Main-st. and the street committee of the village council has visited a number of towns to inspect different kinds of paving.

Veedersburg, Ind.—Special.—I. J. Walker, cy. clk., says that this city contemplates about 1,000 sq. yds. of paving in addition to that for which bids are asked until Aug. 15.

Newport, Ky.—The citizens are in favor of the proposition presented by Mayor Helmbold to issue $100,000 bonds for paving the streets of this city with brick or macadam.

Hollidaysburg, Pa.—This borough voted, July 12, to authorize the council to spend $40,000 for a municipal hall, street improvements and constructing a municipal sewerage system.

Montgomery, Ala.—Resolutions have been adopted to pave the sidewalks on a number of streets with hexagon blocks or Schillinger pavement and graveling the roadways. Thomas H. Carr, Mayor.

Anderson, Ind.—A resolution has been passed authorizing the construction of cement sidewalks on Sixteenth-st. from Madison-ave. to Locust-st., and for improving the alley between Ninth and Tenth-sts. from Jackson to the George Nichol property. Thirteenth-st. is to be paved with brick and gravel. Mayor Forkner.

Peoria, Ill.—Special.—E. W. Woodruff, Mayor, says this city passed an ordinance for recovering asphalt streets. The work contemplated is extensive. The services of an expert whose scientific and practical knowledge of asphalt paving would be of assistance in guarding the city's interest in the work will be desired.

CONTRACTS TO BE LET.

Minerva, O.—Bids are asked until Aug. 18 for 6,000 square yards of brick paving.

Oak Harbor, O.—Bids are asked until Aug. 8 for improving Main-st. L. E. Meyer, village clerk.

Brazil, Ind.—Bids are asked until Aug. 2 for improving certain roads. J. Frank Smith, county auditor.

Winona, Minn.—Bids are asked until Aug. 15 for building stone sidewalks on certain streets.

Napoleon, O.—Sealed bids are asked until 10 a. m., Aug. 2, for constructing country roads. F. J. Beck, county auditor.

Chillicothe, Mo.—Bids are asked until Aug. 15 for paving five miles of streets with brick. Thomas Hurst, city engineer.

Montpelier, Ind.—Bids are asked until 8 p. m., Aug. 16, for improving several streets. J. F. Jones, city clerk.

Fremont, O.—Sealed bids are asked until Aug. 16 for 28,688 square yards of brick paving. George W. Lesher, city engineer.

Ottumwa, Ia.—Bids are asked until Aug. 10 for 25,000 square yards of brick paving and 15,000 feet of cement curbing.

Richmond, Ind.—Bids are asked until Aug. 1 for brick or cement paving on Ft. Wayne-ave. J. F. Taggart, city clerk.

Paoli, Ind.—Bids are asked until 2 p. m., Aug. 5, for constructing several gravel roads. George W. Teagarden, county auditor.

Medina, O.—Bids are asked until Aug. 9 for brick block paving, storm sewers and curbing on W. Liberty-st. O. O. Van Deusen, village clerk.

Lawrenceburg, Ind.—Sealed bids are asked until 12 m. Aug. 2 for constructing a macadam road in Clay township. Charles M. Beinkamp, county auditor.

Warren, O.—Bids are asked until Aug. 2 for improving the free turnpike roads. C. C. Chryst, secy. comrs. rd. dist. No. 1.

Jacksonville, Ill.—Bids are asked until Aug. 1 for 47,156-sq. yds. of brick paving; 27,268-ft. of curbing. C. W. Brown, pub. engr.

Paterson, N. J.—Bids are asked until Aug. 2 for grading and macadamizing roads in certain townships. E. N. Kevitt, dir. bd. freeholders.

Minot, N. D.—Bids are asked until Aug. 9 for building cement or cement and wood sidewalks around the central school property. J. W. Rode, clk.

Salt Lake City, Utah.—Sealed bids are asked until Aug. 8 for constructing macadam roads and cement walks at Ft. Douglas. Capt. Samuel V. Tam. Q. M.

White, Hall, Ill.—Sealed bids are asked until 5 p. m. Aug. 6 for constructing a sidewalk on the north side of Bridgeport-st. F. M. Baldwin, mayor.

Greencastle, Ind.—Sealed bids are asked until Aug. 4 for constructing 2,404.2-ft. stone road in Mill Creek township. Thomas D. Brookshire, chmn, co. cmrs.

Cincinnati, O.—Sealed bids are asked until Aug. 3 for paving Ellison-ave., from Linwood to Totten-aves. with brick. Geo. F. Holmes, clk. B. P. S.

Bluffton, O.—Sealed bids are asked until 12 m. Aug 8 for 5,000 sq. yds. of vitrified brick paving and 2,600 lin. ft. stone curbing. B. F. Biery, vil. clk.

Des Moines, Ia.—Bids are asked until Aug. 4 for Portland cement curbing on Scott and Clark-sts. and until Aug. 11 for vitrified brick and Portland cement curbing.

Wilmington, Del.—Sealed bids are asked until 10 a. m. Aug. 3 for building a macadam road on the Middletown and Odessa Road. C. J. Horrigan, chmn. state highway com.

Bradford, Pa.—Bids are asked until Aug. 8 for constructing 16,237-ft. of road leading from Bradford City to Gilmore, in Foster twp. State highway dept., Harrisburg.

Manchester, Conn.—Sealed bids are asked until 10 a. m. Aug. 8 for grading and constructing about 3,500 lin ft. of macadam road. Thos. H. Weldon, chmn. bd. town selectmen.

Bedford, Ind.—Sealed bids are asked

until p. m. Aug. 4 for constructing gravel or macadamized roads in Bono, Indian Creek, and Marion twps. Amos W. Scoggan, chmn. co. comrs.

Hagerstown, Md.—Sealed bids are asked until 12 m., Aug. 2, for furnishing 70,000 vitrified paving blocks; 100 bbls. Portland cement; 125 tons sand. J. O. Beard, clk. bd. st. comrs.

Tiffin, O.—Sealed bids are asked until 12 m., Aug. 5, for grading, draining, curbing, macadamizing and paving Greenfield-st., from Market to Prospect-sts. John E. Diemer, clk. B. P. S.

Columbus, Ind.—Sealed bids are asked until Aug. 6, for constructing gravel and macadam turnpike roads in Clifty, Columbus, Clay, Nineveh, Ohio and Jackson twps. John Cant, chmn. co. comrs.

Veedersburg, Ind.—Sealed bids are asked until 7 p. m., Aug. 15, for about 15,000 sq. yds. of brick paving and concrete sidewalks and curbing for same on Mill-st. from Seventh to State. I. J. Walker, cy. clk.

Ironton, O.—Sealed bids are asked until Aug. 9 for brick or block paving on furnace cinder foundation on Park-ave., and until Aug. 11 for similar paving on Center and Vernon-ave. Geo. H. Davies, clk.

Woodruff Place, Ind.—Sealed bids are asked until 8 p. m. Aug. 12 for paving the alley between the middle drive and west drive, from the cross drive to Michigan-st., with brick with curbing. George Brown, prest. bd. trustees, Indianapolis.

Indianapolis, Ind.—Sealed bids are asked until Aug. 3 for constructing cement walks on Central-ave. and Prospect-st.; for asphalt paving on Twenty-fifth-st. from Central-ave. to Pennsylvania-st. Bids will be received until Aug. 5 for paving Northwestern-ave. with wooden blocks. M. A. Downing, chmr. B. P. W.

CONTRACTS AWARDED.

Lawrence, Kan.—The contract for 30,000 square yards of brick paving was awarded to Ramsay & Haskins of Topeka at $1.25½ a square yard.

Tacoma Park, Md.—The contract for constructing cement sidewalks throughout the entire town was awarded to the Brennan Construction Co.

Indianapalis, Ind.—The contract for resurfacing Virginia-ave. was awarded, June 30, to the Union Asphalt Construction Co., at $3.50 a lineal foot.

Minonk, Ill.—Chester, Farrell & Co. of this city was awarded the contract, July 18, for paving two blocks of Chester-st. with brick, for $7,450.

Louisville, Ky.—The Standard Asphalt Co. was awarded the contract for paving Dumesnil-st. and Douglass-ave. with asphalt, at $1.78 a square yard.

Newark, N. J.—The contract for laying bitulithic pavement in Bremen-st., from Hamburg to Magazine-sts., was awarded to Warren Bros. of Boston.

Rochester, N. Y.—H. N. Cowles was awarded the contract, July 14, for paving Joseph-ave., from Avenue D to the city line, with brick, for $25,850.

New Orleans, La.—The Barber Asphalt Paving Co. was awarded the contract for paving Carondelet-st., between Napoleon-ave. and Upperline-st., for $20,403.60.

Auburn, N. Y.—Contracts for constructing bitulithic pavements on North-st. and Hamilton-ave. were awarded to Warren Bros. Co. of Boston, July 19.

South Omaha, Neb.—The contract for paving O-st., from Twenty-sixth to Twenty-second-sts., with brick, was awarded, July 18, to Parks, Johnson & Parks, at $2.05 a square yard.

Peru, Ill.—The contract for paving Third and Grant-sts. has been awarded to Berry & Trupeten.

Jamestown, N. Y.—Mahoney Bros. were awarded the contract for paving Washington-st. with brick.

Rockford, Ill.—John Rydblom was awarded the contract for macadamizing a system of streets July 1.

Walla Walla, Wash.—The contract for asphalt paving was awarded to the Barber Asphalt Paving Co. at $2.50 a sq. yd.

Clyde, O.—The contract for paving Buckeye-st. was awarded to George B. Herring & Son of Mansfield, O., for $11,527.55.

Perth Amboy, N. J.—Warren Bros.' Co. of Boston secured the contract for constructing bitulithic paving on Rector-st.

Atlanta, Ga.—Venable Bros. were awarded the contract for repairing the asphalt paving on Peachtree-st. at $1.25 a sq. yd.

Amsterdam, N. Y.—The contract for paving upper Division-st. was awarded July 5 to T. Henry Dumary of Albany for $20,197.

Superior, Wis.—The contract for paving N. Fifth-st. with bitulithic pavement was awarded July 18 to Warren Bros. Co. of Boston.

Omaha, Neb.—Parks, Johnson & Parks secured the contract, July 18, for paving O-st., from Twenty-second-st. to the O-st. viaduct, with vitrified brick, at $2.05 a sq. yd.

Waukegan, Ill.—Rudolph S. Blome & Co., of Chicago, and C. T. Bartlett of Evanston, secured the contracts for constructing cement sidewalks in certain streets.

St. Joseph, Mo.—The contract for paving the driveway in Krug Park for a distance of 1,320 ft., was awarded, July 11, to the Phoenix Brick & Const. Co. for $402.26.

Rome, N. Y.—The Interstate Paving Company was awarded the contract, July 19, for paving N. George, Court and E. Bloomfield-sts., 18,500 sq. yds., at $1.90 a sq. yd.

Jacksonville, Fla.—The contract for paving Main, Ocean and Newman-sts., 1,700 sq. yds., with brick, was awarded to the Jacksonville Tile & Paving Company, at $1.69 a sq. yd.

Marshalltown, Ia.—Elzy & Dunn secured the contract for paving S. First-ave., from Church to Railroad-sts., at $1.85 a sq. yd. for paving and 36 cts. a lin. ft. for curbing.

Toledo, O.—The contract for paving Su-

perior-st., from Lafayette-st. to Swan Creek, with Massillon block, was awarded, July 16, to Bodette & Sheehan, for $8,533.79.

Forest City, Ark.—The contract for constructing a concrete pavement on N. Front and N. Washington-sts., was awarded, July 2, to the Miller Paving Company of Memphis, Tenn.

Albany, N. Y.—The contract for repaving Lancaster-st., from W. Lawrence-st. to the Manning boulevard, with macadam was awarded to the Albany Material and Construction Company for $15,075.

Wyandotte, Mich.—The contract for constructing crosswalks, alley crossings and approaches for the year was awarded July 7 to the Suburban Artificial Stone Company and William Leverance.

Albany, N. Y.—Paving contracts were awarded July 13 as follows: Alexander-st., brick, $8,124.65, and Stephen-st., brick, $4.419.15, John Dayle; Third-st., brick, M. F. Dollard, $4.460.

Manchester, Ia.—The contract for paving the business streets with vitrified brick was awarded to M. Ford of Cedar Rapids July 5 at $1.65 a square yard and 37 cents a lineal foot for curbing.

Decatur, Ill.—The contract for paving N. Park-st., from N. Water to N. Franklin, has been awarded to the Barber Asphalt Paving Company for $2,731.50, and W. Macon-st. for $10,123.32.

Eugene, Ore.—Contracts for grading and graveling streets have been awarded as follows: Harrison and Stewart-aves., Con Meyers; Park and Seventeenth-sts., R. McCulloch; Seventeenth-st., Croner & Mathews.

Cumberland, Md.—Thomas S. Kean was awarded the contract for repaving Washington, Polk and Rebecca-sts. with brick for $21,690, and Mortimer Kean the contract for sidewalk paving on Virginia-ave. for $6,910.

Tacoma, Wash.—The contract for macadamizing Puyallup-ave., from E. G-st. to the city limits, was awarded to Anton Berens for $12,587. Carlson & Swanson secured the contract for improving Thirteenth-st., from C to Tacoma-ave., by planking for $3,308.

Woonsocket, R. I.—Warren Bros. Company of Boston have been awarded the contract for repaving Main-st., from Market-square to Railroad-st., with granite blocks, and for paving Main-st., from Railroad-st. to Monument-square, with brick.

Indianapolis, Ind.—The contract for paving E. Washington-st., from the Belt Railroad to the end of the Irvington pavement with brick with combined curb and gutters was awarded to J. E. Sullivan, representing the Indianapolis Construction Company, at $4.87 lin. ft.

Mankato, Minn.—The contract for grading, curbing, guttering and macadamizing Fifth-st. was awarded to T. R. Coughlan for $14,252. Bids were submittted July 2 for paving Poplar, Jackson and Broadsts., but action was postponed pending the outcome of injunction suits.

Charleston, S. C.—The Southern Clay Manufacturing Company of Chattanooga, Tenn., was awarded the contract for furnishing Robbins shale vitrified paving brick at $2.50 per 1,000, and the Whitmer Construction Company of Charleston the contract for paving Wentworth-st. at $1.56 a sq. yd.

Redondo, Cal.—The contract for the improvement of Beryl-st. was awarded July 11 to Venable & Cloghorn, as follows: Grading and graveling, $1.30 a lin. ft.; cement curbs, 23 cts. a lin. ft.; cement gutters, 35 cts. a lin. ft.; cement sidewalks, 12½c a sq. ft.

Toledo, O.—The contract for paving Dorr-st., from City Park-ave. to the Lake Shore tracks, with asphalt blocks, was awarded July 11 to the Lake Erie Asphalt Block Company for about $66,600. H. B. Streicher was awarded the contract for paving Park-place, from W. Woodruff to Twenty-second-st.

Waverly, Ia.—The contract for paving and curbing six blocks of streets adjoining the business portion of this city was awarded to William Horrabin of Iowa City at $1.49¾ a sq. yd. for flint brick. The contract for curbing was awarded to Russell Bros. of this city at 33 cts. a lin. ft.

Saginaw, Mich.—Z. & J. Lalonde have been awarded the contract for paving Bristol-st., from Hamilton-st. to the Saginaw River; Cleveland Trinidad Paving Company, Bristol-st., from Michigan-

West Bay City, Mich.—Paving contracts have been awarded as follows: Washington-st. from C., S. & M. to Patterson-ave., with brick with concrete curbing, Wm. J. Meagher, $27,560; Litchfield and Washington-sts., from S. Union to Midland-sts., asphalt with concrete, Otto E. C. Guelich; Linn-st., from Midland to Jane-st., brick with Medina curb, Peter Peterson, $7,004.80; Henry and Center-sts., from Fusher-ave. to Second-st., asphalt with concrete curb, Otto E. C. Guelich.

Cincinnati, O.—The L. Drach Const. Co. was awarded the contract July 14 for improving Regina-ave. The contract for paving Seventh-st. was awarded to the Kirchner Co. for $4,148. The Blake Asphalt Maintenance Co. submitted a proposition to the Board of Public Service July 7 for repairing asphalt streets, agreeing to furnish all necessary labor, materials and tools for the work at a rate of $1 a sq. yd. If the board prefers the account system the company is willing to do the repair work under a 25 per cent force account, which it guarantees to keep below the cost of $1 a sq. yd.

Providence, R. I.—Contracts for the construction of highways in the State were awarded July 13 as follows: Placing 25,000 tons of stone in place in town of Cranston, awarded to the town for $3,625; constructing 4,225 ft. in Cumberland, awarded to town for $3,801.04; 5,280 ft. in Gloucester and 5,280 ft. in Smithfield, Amos D. Bridge, $8,517.32; 2,500 tons of stone in place in Scituate, A. D. Bridge;

2,463 ft. of road in North Providence, Lane Const. Co., $2,315.25; 2,490 ft. in Portsmouth, Lane Const. Co., $3,386.14; placing 1,600 tons of stone in West Greenwich, Joseph McCormick, $2,400.

Washington, D. C.—Contracts for furnishing various kinds of paving materials and for laying pavement in various parts of the city were awarded July 5 as follows: Repressed vitrified paving blocks, Clay Product Co., $22.45 per 1,000; asphalt blocks, Washington Asphalt Block and Tile Co., $62 per 1,000; granite curbing, Francis Jones & Co., $1.20 and 95c a lin. ft.; paving certain streets with asphalt blocks, Washington Asphalt Block and Tile Co., $1.77 a sq. yd.; paving certain streets and avenues with sheet asphalt, Cranford Paving Co., $1.57 a sq. yd.; paving with vitrified block, $1.11 a sq. yd.

SEWERS.

Eau Claire, Wis.—A sewer on River-st. is contemplated.

Cherokee, Ia.—A sewer in districts 2 and 3 is contemplated.

Green Bay, Wis.—Considerable sewer work is contemplated.

Clarion, Ia.—A sewerage and waterworks system is favored.

Harlan, Ia.—Estimates are being secured of the cost of a sewer.

Glenwood, Minn.—Estimates for a sewerage system are being made.

Newton, Ia.—City Council has voted to construct a sewerage system.

Rochester, Minn.—A sewer on Grove-st., from Fifth to Seventh, is proposed.

Truckee, Cal.—The construction of a sewerage system is contemplated.

Madison, Minn.—This village voted to issue bonds for a drainage system.

Waseca, Minn.—The question of building a sewerage system is being agitated.

Bay City, Mich.—The construction of a cement sewer in Park-ave. is proposed.

Dubuque, Ia.—The property owners on Sycamore-st. have petitioned for a sewer.

Dyersville, Ia.—Contracts will be let soon for a sewerage system. J. H. Denkhoff, clk.

McPherson, Kas.—The question of constructing a sewerage system is being considered

Bismarck, N. D.—Council is considering a resolution for building a sewerage system.

Sayre, Pa.—The construction of a sewer is being considered by the boro council.

St. Paul, Minn.—The estimated cost of constructing the Ohio-st. sewerage system is $48,566.

Hancock, Mich.—The contract for a sewerage system in West Hancock will probably be let soon.

Quincy, Mass.—An order providing $20,000 for sewer extensions has been passed by City Council.

Oelwein, Ia.—Final action will be taken Aug. 5 for constructing pipe sewers on several streets.

Rosedale, Kas.—Bids will be asked for constructing a 36-inch brick sewer on Shawnee-st.; a 54-inch brick sewer on Wyandotte-st.; a 6-foot sewer across right-of-way of the Frisco R. R. from Wyandotte-st. to Turkey Creek.

Covington, Ky.—Ordinances have been passed for building a number of sewers. J. J. Craig, cy. clk.

Eureka, Kas.—Plans for a sewerage system will be prepared by Burns & McDonnell of Kansas City.

Springfield, Mass.—Bonds have been sold for the construction of the Mill River sewer extension.

Chicago, Ill.—The use of cement in the construction of the new Ninety-fifth-st. system of sewers is urged.

Chattanooga, Tenn.—Sewers are contemplated for Williams and Cherry-sts., in South Chattanooga.

Washington, N. J.—The question of constructing a sewerage system will probably be voted on in August.

Hollidaysburg, Pa.—Borough Council has been authorized to issue bonds for a municipal sewerage system.

Black Diamond, Cal.—An approximate estimate of the cost of a sewerage system is from $10,000 to $12,000.

Bozeman, Mont.—The construction of about 2,500 ft. of 6-in. sewers is contemplated. C. M. Thorpe, cy. engr.

Grand Rapids, Mich.—The committee on septic tanks for the Soldiers' Home will render a full report Aug. 3.

Amarillo, Tex.—A sewerage system will be established. Surveys are being made by John B. Hawley of Ft. Worth, Tex.

Lambertville, N. J.—Council has appropriated $400 for the purpose of employing an expert engineer to prepare plans for a sewerage system.

Duluth, Minn.—The city engineer has been directed to prepare plans for establishing a sewerage system for Duluth Heights. Mayor Cullum.

Centralia, Ill.—An ordinance has been passed providing for an outlet sewer for the system recently contracted for. The estimated cost of the proposed outlet sewer is $18,000.

Lowell, Mass.—The committee on sewers decided, July 12, to ask for $35,000 to carry on the work of sewer construction the remainder of the year, and for lowering the sewer in City Hall-ave.

Lexington, Ky.—John T. Shelby, W. A. Gunn, Dr. E. M. Wiley, J. W. Porter and Alex. Pearson have been appointed a committee to investigate the question of issuing $100,000 bonds for constructing a sewerage system

St. Paul, Minn.—City Engineer Rundlett has prepared estimates on three plans for completing the St. Anthony Park sewer system. One plan provides for the completion of the system according to the preliminary order of the council approved Aug. 22; plan No. 2, the completion of that system and a main sewer to drain to the State farm; No. 3, the completion of the St. Anthony Park system, the State farm sewer and a main sewer to drain the State fair grounds.

CONTRACTS TO BE LET.

Corning, Ia.—Bids are asked until Aug. 3 for building a sewer. S. E. Day, city clerk.

Poplar Bluff, Mo.—Bids are asked until Aug. 8 for a sewer in Eighth-st. William A. Spence, city clerk.

Harrison, N. J.—Bids are asked until Aug. 2 for a pipe sewer in N. Fifth-st. B. P. Walsh, town clerk.

Hamilton, O.—Bids are asked until Aug. 2 for building sewers in several streets. John B. Connaughton, clerk.

Monticello, Ind.—Sealed bids are asked until 7 p. m., Aug. 2, for building a sewer. W. J. Gridley, town clerk.

Fon du Lac, Wis.—Bids are asked until Aug. 3 for constructing a storm water sewer on E. Division and Union-sts.

Tell City, Ind.—Sealed bids are asked until 7:30 p. m., Aug. 10, for constructing a stone pipe sewer. Frank Hinkel, city clerk.

Iowa City, Ia.—Bids are asked until 2 p. m., Aug. 5, for constructing about 100 feet of brick sewer. F. H. Dondore, city clerk.

Montpelier, Ind.—Bids are asked until 8 p. m. Aug. 16 for constructing a salt-glazed vitrified sewer. J. F. Jones, cy. clk.

East St. Louis, Ill.—Sealed bids are asked until Aug. 13 for constructing the outlet sewer and pumping works. Prest. bd. local impvts.

Boonville, Ind.—Bids are asked until 2 p. m. Aug. 8 for constructing a sewer drain in the county jail and court house. R. D. O. Moore, co. audt.

DePere, Wis.—Bids are asked until 4 p. m. Aug. 9 for 1,200 ft. of 20-in. pipe sewer on Merrill-st. and 700 ft. of 15-in. pipe sewer on Lande-st. Cy. clk.

Anadarke, Ok.—Sealed bids are asked until 6 p. m. Aug. 6 for making a survey, plans and specifications, etc., for a sewerage system. B. E. Beebe, cy. clk.

Fremont, O.—Sealed bids are asked until Aug. 16 for constructing 5,950 ft. of 9, 15, 18 and 20 in. pipe sewer. C. H. Bauman, clk. B. P. S.; Geo. W. Lesher, cy, engr.

Janesville, Wis.—Bids are asked until Aug. 5 for 13,860 feet of sewers in district No. 5; 6,430 feet in district No. 6; 6,040 feet in district No. 11; 9,530 feet in district No. 12. City clerk.

Chicago, Ill.—Sealed bids are asked until Aug. 24 for deepening about 2,000 feet of the west fork of the south branch of the Chicago River. Zina R. Carter, president Board of Trustees.

Des Moines, Ia.—Sealed bids are asked until Aug. 4 for constructing a sixteen-foot concrete culvert across the Seventh Ward drainage ditch at E. Walnut-st. W. W. Wise, chairman B. P. W.

Washington, D. C.—Sealed bids are asked until Aug. 8 for constructing the Four-and-a-Half-st. high-level intercepting sewer and sewage disposal system. H. B. F. MacFarland, chairman District Commissioners.

Chicago, Ill.—Sealed bids are asked until Aug. 3 for constructing a sewage pumping station, including buildings, foundations, machinery and all appurtenances. A. M. Lynch, president Board of Local Improvements.

South Bend, Ind.—Bids will be received until 10 a. m., Aug. 3, for building local sewers in Van Buren, Allen, Bronson, Marietta, Osborne and Birdsell-sts. and Cottage Grove, Blaine and Cleveland-aves. A. J. Hammond, city engineer.

Janesville, Wis.—Sealed bids are asked until Aug. 5 for building sewers in districts Nos. 56, 11 and 12 as follows: 27,031 feet ten-inch, 2,833 feet ten-inch, 2,373 feet twelve-inch, 725 feet fifteen-inch, 1,686 feet eighteen-inch, 648 feet twenty-four-inch, 881 feet twenty-seven-inch, 103 manholes, nineteen lampholes. C. V. Kerch, city engineer.

Columbus, O.—Sealed bids are asked until Aug. 10 for furnishing and erecting the pumping plant for the main sewage pumping station, consisting of three 11,000,000-gallon and two 4,000,000-gallon centrifugal pumps, each connected to a vertical compound condensing engine; two ten-kw direct-current generators connected to simple engine; one switchboard, water tube boilers, two surface condensers, two air pumps, two boiler and feed pumps, etc. Charles H. Frank, secretary B. P. S.

CONTRACTS AWARDED.

Ottawa, Ill.—James J. Dougherty has been awarded contracts aggregating $26,486.42 for constructing sewers.

Cherokee, Ia.—The contract for a sewer was awarded to Shepherd, Harrahan & Co. of Des Moines for $10,285.

Nashville, Tenn.—The contract for building a pipe sewer in an alley was awarded to P. M. Warden for $465.90.

Aurora, Ill.—The contract for building sewers in district No. 6 was awarded to H. D. Hallett, city, for $12,880.

Cincinnati, O.—The L. Drach Co. was awarded the contract for a sewer in Glenway and Carson-aves. for $7,694.90.

Marshall, Mo.—The contract for building a district sewer was awarded to Dunnegan & Sykes of Shenandoah, Ia., for $7,189.

Boise, Idaho.—The contract for sewer and water works construction was awarded to James Kennedy of Fargo, N. D., for $130,000.

Xenia, O.—The contract for building lateral sewers was awarded to Williams & Huenker of Springfield July 19 for $39,000.

Terre Haute, Ind.—The contract for sewers on Spruce, Nineteenth and Twenty-third-sts. has been awarded to Jesse Robertson for $3,851.53.

Greensboro, N. C.—The contract for a septic tank with outfall and sewer pipe was awarded, July 15, to J. T. Pruden, city, for $4,800.

Oneida, N. Y.—A. W. Fitch was awarded the contract for constructing sewers in Willow and Stone-sts. and Washington-ave., for $4,697.40.

St. Paul, Minn.—The contract for building a sewer on Duluth-ave. and Minnehaha and Beech-sts., was awarded to Christ Johnson, for $3,229.

Los Angeles, Cal.—The contract for constructing the outfall sewer from this city to the ocean was awarded to S. J. Edwards of Pasadena, for $565,000.

Lancaster, Pa.—The contract for building a new sewer for the northern section of the city was awarded, July 9, to George Stone & Co of Philadelphia, for $185,000.

Washington, D. C.—The contract for furnishing terra cotta sewer pipe and other material for sewer construction was awarded to William Wirt Clarke & Son, for $19,820.

Bartonville, Ill.—Charles O'Neill has been awarded the contract for insta...ng a subsidiary sewerage system communicating with the main pipe of the Bartonville Asylum, for $4,115.

Birmingham, Ala.—The contract for constructing the Village Creek branch of the county trunk sewer, extending from East Like to Ensley, has been awarded to Wright, Williams & Watley, for $77,465.

West Bay City, Mich.—Sewer contracts were awarded, July 7, as follows: Blend-st., P. Ryan & Co., $492; Fremont-st., $544.20; Dean-st., $1,063.80, and Litchfield-st., $450, M. O'shea; Henry-st., Peter Peterson, $2,596.

New Orleans, La.—The contracts for constructing drainage channels, sewage pumping stations and other work, have been awarded as follows: Contract P, W. M. Wren & Co., $35,063.54; contract U, Dowdie & Windett, $92,650; contract Z, Dowdie & Windett, $92,370; contract 7, Thomas Egan, $30,335.25.

WATER-WORKS.

Winthrop, Mass.—The citizens of this city voted, July 14, to purchase the plant of the Revere Water Company.

St. Louis, Mo.—The Whitney Artesian Well Company has been incorporated to drill water, gas and oil wells.

Sauquoit, N. Y.—The Sauquoit Water Works Company has been incorporated by Chas. K. Garlick, Ladd J. Lewis, jr., and Zacariah P. Townsend.

CONTEMPLATED WORK.

Forest City, Ia.—The extension of the water mains is proposed.

Traverse City, Mich.—The citizens voted to extend the water mains.

Rock Island, Ill.—Council has authorized the extension of the water mains.

Ft. Wayne, Ind.—Plans, and specifications are proposed for a new standpipe.

Jackson, Miss.—This city voted to issue $250,000 for the purchase or erection of water works.

Springfield, Ill.—An ordinance has been introduced providing for the adoption of water meters.

Slippery Rock, Pa.—The question of constructing a water works system will be voted on Aug. 9.

Eldridge, Ia.—Special. This town has again rejected all bids for constructing a water works system.

Knoxville, Tenn.—This city voted to issue $750,000 for the purpose of erecting a municipal water plant.

Tomahawk, Wis.—The improvement of the water works system and its extension to West Tomahawk is contemplated.

Montreal, Can.—N. Hanson Greene, 207 St. James-st., is in the market for pumps, water works supplies, water wheels, etc.

Minneapolis, Minn.—The purchase or rental of a pitometer to measure the flow of water in the various mains is contemplated.

Buffalo, N. Y.—Special.—Bids will be asked soon for constructing a pipe-line in Pearl-st. from Buffalo Run to Chippewa-st.

The question of issuing bonds for the construction of water works systems will be voted on as follows: Waupaca, Wis., Aug. 12; New Carlisle, O.

Johnson City, Tenn.—The Wausauga City Water Company contemplates building an emergency reservoir on Jenny's hill, one mile east of this city.

Muskogee, I. T.—The question of issuing $100,000 bonds for the extension and improvement of the water works plant will probably be voted on.

Asheville, N. C.—The construction of a large reservoir at the old rock quarry on the side of the mountain east of this city is being considered.

West Springfield, Mass.—The water commissioners have decided to submit to vote the question of purchasing the Bear Hole water supply as an auxiliary.

Lexington, N. C.—Surveys, plans, specifications and estimates for water works, electric light plant and street improvements will be prepared by J. L. Ludlow, C. E.

Flushing, N. Y.—Plans have been prepared for a new 20-in. main to connect the Flushing pumping station at Kissena Lake with the large Flushing standpipe reservoir.

Tacoma, Wash.—A special committee has been appointed to investigate the water supply of this city and to consider the advisability of eliminating Clover Creek from the source of supply.

Miles City, Mont.—The question of constructing the Tongue river pumping station, including a well, a pump house with necessary apparatus, 2 new boilers and a pipe line, is being considered.

The question of issuing bonds for constructing water works systems has been favorably voted on as follows: Leesburg, Va.; Benton, Pa.; Emporia, Va.; Abbotsford, Wis.; East Toronto, Ont.; Summerside, P. E. I.; Creedmore, Ont.

The construction of water works systems is contemplated at the following places: Clarion, Ia.; Colman, S. D.; Harvey, N. D.; Otterbein, Ind.; Abbeville, La.; Crestline, O.; Clear Lake, Wis.; Staunton, Va.; Betterdorf, Ia.

Colfax, Wash.—City Council decided,

July 12, to employ an expert engineer to investigate the feasibility of bringing water from a point north of this city to the city pumping station for the purpose of supplying power for a turbine water wheel.

CONTRACTS TO BE LET.

Camden, N. J.—Bids are asked until Aug. 29 for 20,000 feet of thirty-inch pipe. L. Farnham, city engineer.

Atwater, Minn.—Bids are asked until Aug. 6 for constructing a water works system. O. H. Larson, clerk.

Halstead, Minn.—Bids are asked until Aug. 8 for constructing a water works system. Ole O. Sjordal, village recorder.

Belleplaine, Ia.—Bids are asked until Aug. 15 for constructing a water works system. J. C. Milner, mayor.

Warrensville, S. C.—Bids will be received until Aug. 3 for constructing a water works plant. Warren Manufacturing Company.

Attleboro, Mass.—Sealed bids are asked until Aug. 10 for constructing a concrete-steel standpipe. George H. Snell, superintendent Water Commissioners

Prescott, Ariz.—Bids are asked until Aug. 20 for constructing a water distributing system and reservoir. Capt. Charles C. Walcutt, jr., G. M.

Grand Rapids, Minn.—Bids are asked until Aug. 8 for 1,950 feet of six-inch water mains, 412 feet four-inch pipe and connections. J. S. Gole, village recorder

Philadelphia, Pa.—Sealed bids are asked until 12 m., Aug. 2, for improvement, extension and filtration of the water supply. Peter E. Costello, director.

Galveston, Tex.—Sealed bids are asked until 12 m. Aug. 3 for the erection of the water park pumping station. H. C. Lange, water works and sewerage comr.

Columbus, O.—Sealed bids are asked until Aug. 10 for furnishing and laying c. i. pipe across and adjacent to the Scioto River. Chas. H. Frank, secy. B. P. S.

Chicago, Ill.—Sealed bids are asked until Aug. 31 for furnishing and installing turbine water wheels and governors. Zina R. Carter, prest. bd. drainage trustees.

Milwaukee, Wis.—Sealed bids are asked until Aug. 2 for furnishing 500 tons of 6-in. and 50 tons of 10-in. c. i. water pipe. Chas. J. Poetsch, chmn. B. P. W.

Rockport, O.—Bids are asked until Aug. 8 for furnishing water pipe, special castings and miscellaneous castings, and hydrants and cranes, etc. W. L. Nichols, vil. clk.

Fort Meade, S. D.—Sealed bids are asked until Aug. 18 for a 500,000-gal. reinforced concrete reservoir, putting in new water distributing system consisting of 719 ft. 8-in., 11,320 ft. 6-in. pipe and 41 fire hydrants. George L. Byram, Const. Q. M.

Brandon, Man.—Sealed bids are asked until Aug. 8 for furnishing and erecting in the water works pumping station one compound condensing vertical pumping engine; one triple expansion condensing vertical pumping engine. Only one engine will be purchased. J. B. Whitehead, secy.-treas.

Roswell, N. Mex.—Bids are asked until Sept. 6 for constructing an earthen dam retaining embankments, spillways, gates, pipe conduits, and 3½ mis. of canal for the purpose of conducting the flow of water of the Hondo River to a reservoir 12 mis. southwest of this city. Thos Ryan, acting secy.

CONTRACTS AWARDED.

Albia, Ia.—A water works franchise was granted to C. A. Rees, of Tahlequah, I. T.

Marietta, O.—The contract for water works extensions was awarded to Philip Sheets, of Newcomerstown, for $21,000.

Whitman, Mass.—The contract for furnishing c. i. pipe was awarded to the New England Pipe and Cement Co., of Boston.

Dayton, O.—The contract for furnishing 800 water meters was awarded, July 20, to Henry R. Worthington, of New York City, at $8 each.

Kasson, Minn.—The contract for the extension of the water mains was awarded July 18 to W. I. Gray & Co., of Minneapolis, for $3,357.

Erie, Pa.—The contract for the extension of the big intake pipe was awarded July 11 to the T. A. Gillespie Co., of Pittsburg, for $195,968.58.

Houghton, Mich.—The contract for the construction of the reservoir and pipe lines for the new water works system was awarded to Johnson & Latteral, for $33,971.

Evanston, Ill.—W. S. Moore secured the contract for constructing a water main in Grey-ave. for $962.50 and in E. Railroad and Stanley-aves. for $2,583.85, and James Wigginton, jr., the contract for a main in Asbury-ave. for $384.50.

BRIDGES.

Crawfordsville, Ind.—Bids are asked until Aug. 2 for constructing nine bridges. County Commissioners.

Covington, Ky.—The central bridge will be overhauled and repaired. County clerk, Newport.

Clarksburg, W. Va.—The construction of a steel bridge over West Fork River. County Commissioners.

Wabash, Ind.—Bids are asked until Aug. 8 for constructing five steel bridges. Thomas Nugent, county auditor.

Fargo, N. D.—Bids are asked until Aug. 4 for constructing several bridges. Arthur G. Lewis, county auditor.

Brownstown, Ind.—Bids are asked until 9 a. m., Aug. 4, for building fourteen bridges. A. H. Manuel, county auditor.

Bloomington, Ind.—Bids are asked until Aug. 2 for constructing several bridges. William H. Deckard, county auditor.

Delphi, Ind.—Bids are asked until 2 p. m., Aug. 1, for constructing approaches to two bridges. John Nevin, chairman County Commissioners.

Versailles, Ind.—Bids are asked until

Aug. 2 for constructing a wagon bridge across Pipe Creek. Nicholas Volz, county auditor.

Rock Island, Ill.—Sealed bids are asked until Aug. 1 for a steel highway bridge over Rock Island River. Wallace Treichler, cty. engr.

Chillicothe, O.—Bids are asked until Aug. 1 for building a steel riveted hign truss bridge over Paint Creek. Charles H. Pinto, co. audt.

Pittsburg, Pa.—Bids are asked until Aug. 14 for constructing the Wilmet-st. bridge, which will be 700 feet long. E. M. Bigelow, dir. pub. wks.

Savannah, Mo.—Sealed bids are asked until 12 m., Aug. 20, for constructing a large number of bridges and culverts. J. E. Schnitzius, rd. & br. cmr.

Washington, D. C.—Sealed bids are asked until 2 p. m., Aug. 5, for constructing stone bridges on the Antietam, Md., Battlefield. Capt. A. W. Butt, Q. M.

Glasgow, Mont.—Bids are asked until Aug. 4 for constructing a combination bridge over Frenchman Creek, on steel tubular piers. R. J. Crossett, clk.

Chicago, Ill.—Plans for a bridge at Archer-ave., to cost $125,000, and one at North-ave., to cost $150,000, are being prepared by City Engineer Ericson.

Madison, Ind.—Bids are asked until Aug. 3 for masonry work on Roseberry bridge in Deputy-road, and Taylor bridge on Brownstown-road. G. F. Crozier, co. audt.

Indianapolis, Ind.—Sealed bids are asked until Aug. 9 for building a bridge over White River at Crow's Nest, Washington twp. John E. E. McGaughey, chmn. co. comrs.

Ionia, Mich.—The citizens of Ionia twp. have voted to issue $10,000 bonds for building a new bridge ½-mi. up the river to replace one washed out recently by the flood.

Pawtucket, R. I.—Bids are asked until Aug. 1 for building a steel plate girder bridge across Blackstone River, between Pawtucket and Central Falls. Cross st. br. comn.

Newark, O.—Bids, including plans, for constructing the superstructure of Mears bridge in Monroe twp., and one span of Horn's Mill bridge in Newark twp. A. R. Pitser, co. audt.

Des Moines, Ia.—Sealed bids are asked until Aug. 4 for constructing a 16-ft. concrete culvert across Seventh Ward drainage ditch at E. Grand-ave.; also, at E. Walnut river. W. W. Wise, chmn. B. P. W.

Harrisburg, Pa.—Sealed bids are asked until Aug. 2 for rebuilding the sub-structure and superstructure of the bridge over Connoquenessing Creek at the point of crossing of the Zelienople and Newcastle road. J. M. Shumaker, supt. pub. grounds and bldgs.

Lafayette, Ind.—Sealed bids are asked until Aug. 3 for building a steel bridge over Wildcat Creek at App's mill; for repair of abutments of Weaver bridge, Perry twp., with Portland cement concrete; also for furnishing Portland cement concrete per yd. and put in arch culvert at cross roads east of Monitor. Harvey H. Cheney, co. audt.

Everett, Wash.—Special—W. D. Barkhuff, cy. engr., says the contract for the construction of the proposed bridge to be built across the Snohomish river was awarded to A. C. Goerig, representing the Wisconsin Bridge Company, for $35,600. The bridge will consist of a swing span about 233-ft. long, and 2 fixed spans 124-ft. long. The foundations are to be concrete filled cylinders.

South Bend, Ind.—Sealed bids are asked until 10 a. m., Aug. 18, for piling per lin. ft. in place; removal and erection of present truss bridge at temporary site north of street line and ready for travel; removal of temporary bridge up the river to a point to be determined by the county commissioners to be done when the bridge is completed. The plans on file provide for a concrete bridge of the Melan arch type of 4 spans, with total length of 554-ft. John W. Harlow, co. audt.

STREET LIGHTING.

Decatur, Ala.—An electric light plant is proposed.

Nevada, Ia.—The installation of a gas plant is contemplated.

West Point, Ia.—This town voted, July 12, to build an electric light plant.

Little Rock, Ark.—An electric light system is proposed for Pulaski Heights.

Battle Creek, Ia.—This town has voted to issue $4,500 for establishing a gasoline plant.

Kissimmee, Fla.—This city voted to issue $25,000 municipal electric light and power plant bonds.

Williamstown, Pa.—The contract for lighting the streets for five years has been awarded to the Williamstown Electric Company.

Camden, N. J.—Bids are asked until Aug. 29 for a small electric light plant in the pumping station. L. E. Farnham, cy. engr.

Timmonsville, S. C.—Estimates are being invited for establishing an electric light and water works. A. J. Brown, town sec.

Ft. Myer, Va.—Sealed bids are asked until 10 a. m., Aug. 2, for addition to acetylene gas plant at this post. Capt. G. C. Barnhardt, Q. M.

Greene, Ia.—The business men have formed a stock company to manage the city's electric light plant, and will make extensive improvements.

New York City—The board of estimate decided, July 1, to contract with the Consolidated Gas Co. to furnish 22,500 Welsbach lamps, at $24.75 a lamp.

Lockport, N. Y.—Special.—A new power canal, involving an expenditure of $10,000,000, is contemplated by the Niagara County Irrigation & Water Supply Co., recently incorporated.

Indianapolis, Ind.—Bids will be received until Aug. 1 for public lighting of this city, not included under the contract recently made with the Indianapolis Light

& Power Co. M. A. Downing, chmn. B. P. W.

Lexington, Ky.—Bids are asked until Aug. 1 for erecting two K. W. generators and engines complete; also a 75 K. W. generator with slow speed engine. J. S. Redwine, supt. Eastern Ky. Asylum for Insane.

Massillon, O.—Bids are asked until Aug. 11 for furnishing and erecting on foundation furnished by Hospital, a 450-H. P. 4-vaive engine, to run at a speed of 110 R. P. M. H. C. Eyman, secy. bd. trustees Massillon State Hos.

McKeesport, Pa.—The finance committee favorably recommended July 8 an ordinance providing for issuing $125,000 bonds to build a municipal light plant. It passed and the question will be submitted to vote in December.

Brooklyn, N. Y.—Bids are asked until Aug. 3 for furnishing and installing steam engines, generators and electric lighting at Jamaica and Springfield pumping stations and electric wiring at Ridgewood pumping stations and Mt. Prospect reservoir and tower, including lamps, fixtures, switchboards and other appurtenances. John T. Oakley, comr. water, gas and electricity.

Peoria, Ill.—Sealed bids are asked until 12 m. Aug. 15 for furnishing not less than 2,675 electric street lights of not less than 2,000 c. p.; also, 32 c. p. incandescent lamps for alley lighting; furnishing electric current for lighting the city, city hall, jail, fire department houses, houses of correction, detention hospital, patrol houses and office of draw of lower free bridge. Robert Joss, cy. clk.

PARKS.

Camden, N. J.—The Payne Poynt Park is to be enlarged.

New York City—Plans are being prepared for a seaside park on the Rockaway site.

Meridian, Miss.—A special election will be held to approve the proposed issue of $40,000 for a park system here.

Dayton, O.—W. L. Olmstead, landscape gardener of Boston, will devise plans for converting the Patterson homestead into a beautiful park.

Harrisburg, Pa.—J. D. Cameron, ex-Senator, has donated a large tract of land to this city for park purposes and elaborate plans have been prepared by Manning Bros. of Boston.

FIRE APPARATUS.

Dover, Del.—The Gamewell Fire Alarm & Telegraph Company has been awarded the contract for putting a fire alarm system in this city for $2,100.

Mishawaka, Ind.—Sealed bids are asked until 6 p. m. Aug. 1 for furnishing a complete and modern fire alarm system, consisting of 158 round fire alarm boxes; 1 combined 15-in. gong and 3-number visual indicators; 1 8-in. gong for water works pumping station; 1 2-circuit automatic storage battery switchboard and battery with battery racks; 1 2-circuit repeater with cabinet; 1 transmitting box and wheels. M. M. Mix, Mayor.

GARBAGE DISPOSAL, STREET CLEANING AND SPRINKLING.

London, Ont.—A garbage plant has been recommended for this city.

Crafton, Pa.—Bids are asked until Aug. 2 for constructing a garbage furnace. W. O. H. Elliott, borough clerk.

Los Angeles, Cal.—The city clerk has been directed to secure bids for supplying this city with two sweepers.

Atlantic City, N. J.—An ordinance was passed second reading July 11 for awarding a contract for the destruction of this city's garbage for one year to the Atlantic Products Company for $20,300.

TOO LATE FOR CLASSIFICATION

Plainfield, Ill.—A sewerage system is proposed.

Appleton, Wis.—This city voted to construct a municipal water works system.

Kellogg, Ia.—This town voted to issue $4,000 bonds for building an electric plant.

Yorkville, Ill.—The village bd. decided, July 18, to install iron water mains to replace the old wooden pipes.

Chicago Junction, O.—Sealed bids are asked until Aug. 13 for curbing Metson and Park-sts. G. B. Miller, clk. pro tem.

Fredonia, N. Y.—The contract for about 2,000-ft. of paving on Temple-st. was awarded to T. J. Fitzgerald, for about $18,000.

Richmond, Ind.—Sealed bids are asked until Aug. 1 for building cement sidewalks. J. F. Taggart, cy clk.

Lewiston, Idaho.—Plans for the E. Main-st. sewer system, embracing 10-mis. of sewer pipe, have been submitted by Engineer Millar.

Hamilton, O.—Sealed bids are asked until Aug. 2 for building storm sewers on Central-ave. and Heaton-st. J. B. Connaughton, clk. B. P. S.

Hammond, Ind.—Bids are asked until Aug. 16 for a concrete sidewalk on Douglas-st. and vitrified pipe sewers on two streets. W. F. Bridge, cy. engr.

Marshall, Tex.—The contract for building the disposal plant for the sewerage system has been awarded to the Taylor-Moore Const. Co., of Gainesville, for $3,000.

Chicago, Ill.—Sealed bids are asked until Aug. 4 for cut stone, granite or Bedford stone, for the Thirty-ninth-st. pumping station. F. W. Blocki, comr pub. wks.

Nashville, Tenn.—The contract for building sewers in Peabody-st. was awarded, July 21, to John Broderick & Son, for $306.90; sewer in Bank-alley, Nashville Plumbing Co., $212.20; combined curb and gutter on Meridian-st., John Tarpley, 35 cts. a lin. ft. for curb and 35 cts. for gutter.

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